

# Railway Age Gazette

MECHANICAL EDITION  
INCLUDING THE  
AMERICAN ENGINEER

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## Don't Miss This Competition

The competition which closes on January 1, 1916, and which was announced for the first time in our November issue, page 554, should prove the largest and best that we have yet held. Every wide-awake officer or foreman has met with success in trying out some idea or scheme to secure more effective and more efficient work from his staff or department. Sometimes a very little thing will do much to inspire and encourage the men to greater and more efficient efforts. Cutting out lost motion and useless work and making every move count has resulted in important gains being made in more economical operation or in increased capacity of a shop, engine house, car repair yard, drafting room or other unit. We want to bring out these things and get the benefit of your experience. For each of the best three letters, from a practical standpoint, telling of experiences of this sort, prizes of \$10 will be awarded. They must be received on or before January 1, 1916, and must not contain more than 700 words. Other letters which may be selected for publication will be paid for at our regular rates.

## Efficiency in

### Railroad Shops

"How the Old Man Beat Them to It" sounds a bit flippant or undignified as the title of an article in a strictly technical publication of the nature of the *Railway Age Gazette, Mechanical Edition*. Be that as it may, the article is a most readable one and Mr. Wolcomb, the author, takes advantage of the opportunity to drive home the fact that, after all, efficient and economical shop management is based strictly on the application of simple, sound common sense. If the foremen and the men in the ranks can be encouraged to make suggestions, and the best of these are followed up with good judgment, remarkable savings may often be made at little or no expense for additional equipment and facilities. This has been thoroughly demonstrated in other departments of railway work. For instance, take the safety first movement; the freight loss and damage prevention campaigns, which are bearing such fruitful results; or the progress which has been made on a number of roads in improving car and trainloading by educational methods and co-operation on the part of all of the employees interested. The success of all of these movements has depended largely on individual effort and the following up of suggestions which have

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been advanced by men in all branches of the service. Some of the very best suggestions have come from the rank and file. Encourage the men in your shop or department to co-operate in this way.

#### The Value of

##### Home-Made Tools

It is this: "Instead of buying new machines now, the foremen and men get their heads together and build a machine at much less cost that does the work just as well as an expensive tool. You can see for yourself the great number of home-made 'kinks' around the shops and yard." In all probability the author referred to special tools or kinks for jobs which could not be handled to advantage on standard machine tools, or which were not numerous enough to justify manufacturers in developing special machines to handle them. It is doubtful if any railroad shop or repair yard can develop a satisfactory machine tool at a cost nearly as low as that for which it could be purchased from a manufacturer who specializes in the building of the same type of tool. On the other hand, savings may often be made in the railroad shop by contriving simple tools or apparatus which will enable a standard machine to better meet the requirements for some special class of work.

#### Locomotive Boiler Inspection Competition

foreman of the Atchison, Topeka & Santa Fe at La Junta, Col. In general he discusses the qualifications of a successful inspector and the facilities and methods which should be placed at his disposal. In addition, he emphasizes the vital necessity of coaching these men in order that they may develop to the fullest extent, and of backing them up and supporting them so that there may be no question as to their authority in seeing that repairs are fully and properly made. We also publish with Mr. Ryan's article the contribution by W. J. Gillespie, boiler inspector of the Pittsburgh & Lake Erie at McKee's Rocks, Pa. Mr. Gillespie's treatment of the subject is very different from that of Mr. Ryan and goes more fully into the actual details of making the inspections. A number of splendid suggestions are made in the other contributions which were received, the best of which will be published in following issues.

#### The Car Inspector Problem

material from which to develop good inspectors. These are low pay and long hours. Those who are at all familiar with the requirements of this position can realize the force of these reasons; and the first cause—low salary—applies with equal force more or less generally to car department foremen. For instance, the foreman of an important steel car repair shop receives a salary of \$75 a month; the foreman of the locomotive boiler shop, hardly a stone's throw away, receives a monthly salary of \$150. It may be argued with more or less force that the boiler shop foreman is in charge of more important or more exact work and requires a wider knowledge and greater experience than the steel car repair shop foreman. Grant that this is so; but does it require any less effort or executive ability to get results from a group of typical car repair men than from trained boilermakers, and are these two salaries at all proportionate? Here is another case: A car foreman at an important point receives \$80 a month, which is about the same amount as is paid to the car inspectors at that terminal. At least three men working on the car repair tracks regularly earn from \$100 to \$120 a month on a piecework basis. Will these men give up their jobs to be promoted to a salaried position of greater re-

One statement in Mr. Wolcomb's article on "How the Old Man Beat Them To It" may be questioned as to correctness.

sponsibility, necessitating harder work and longer hours, for from 20 to 33 per cent less compensation? What are the possibilities for further advancement which would justify them in taking this step?

#### Getting Results

##### from a Big

##### Engine Terminal

are constantly arising requiring new practices to be developed. In periods of heavy traffic, or, indeed, at almost any time, the engine terminal is a strategic point in the operation of a division, and the efficiency of the division or of the road is largely dependent on it. It is a vitally important task, then, to organize the forces and operate the terminal as a whole in such a way as to co-operate to the best advantage with the other parts of the operating organization. For an engine house, large or moderate size, what is the best plan of organization? It is understood, of course, that it will depend to a certain extent on local conditions of traffic, including the relative number of freight and passenger trains, and the class of freight trains. In attempting to answer this question, therefore, the special conditions under which the organization has proved successful should be outlined roughly. What equipment is necessary, both in the engine house and outside, to secure the most effective results? What about the labor problem? What special methods of operating a terminal or any one of its important departments have proved most successful? How can terminal delays to locomotives best be avoided? Are there any methods that can be applied to engine houses or their organization, in general, to prevent engine failures? These are some of the questions which might profitably be considered in connection with a study of "The Handling of a Big Engine Terminal," and are only intended as suggestions. We will give a prize of \$35 for the best article on this subject, judged from a practical standpoint, which is received on or before February 1, 1916. Other articles which may be accepted for publication will be paid for at our regular space rates.

#### A Field for the Special Investigator

It is of paramount importance that the mechanical department officers keep thoroughly in touch with the service performed by both the cars and locomotives under their control. Special men, or general inspectors, as they are sometimes called, should be assigned to this work—men who have had sufficient technical education and practical training to diagnose the troubles that may be found in all types of equipment. When a new device is installed it should be the duty of these men to see that it is handled properly and to follow it in service to determine whether or not it is advisable to use it generally, or whether it would serve better on certain classes of equipment only. When an epidemic of trouble occurs, such as hot boxes, leaking tubes, etc., these special investigators would be in an excellent position to ferret out the causes and apply the remedy at the root of the trouble. By concentrating the investigation of these problems in the hands of one man far better results will be obtained than by attempting to judge the merits of any case from the special reports of the various master mechanics.

When the purchase of new power or cars is considered these men should make a study of the conditions in order that the most suitable equipment may be procured. An excellent example of what might have been accomplished, had this plan been followed, is found in the case of a certain large road. A few years ago it purchased a large number of fairly heavy superheater Mikado locomotives. A study of the conditions after they had been in service for some time showed that locomotives of materially less power, superheater Consolidations, would have answered the purpose fully as well and at less investment cost. The determination of the kind and the construction of equipment is left too much in the hands of the builders. Not that their advice should

not be solicited, for they, being specialists, are in a position to offer great assistance. Their experience, however, is general and is gained from dealing with many roads. They have no opportunity to know the special conditions existing on each road.

Another field for these special investigators is in the determination of the tonnage ratings of the power. The mechanical man should know what the locomotives are capable of doing. If they are not performing their full duty investigations should show the reasons. The trouble may be due to the design or it may be due to improper maintenance. In both cases the mechanical officers will have a complete and concise report from one man and they will be in the best position possible to apply the remedy.

#### Our Change in Name

*Railway Age Gazette, Mechanical Edition*, is a bulky and unsatisfactory name for a publication. While it defines the field that is covered, it makes unnecessary labor in correspondence and reference and is often confused with the weekly edition of the Railway Age Gazette. It was decided some time ago to change to a more simple and less confusing name; this change will be made in our next number, January, 1916. The selection of the new name was no easy task. Two requirements had to be filled—the name must be short, and it must fully define the scope of the publication. Obviously it was necessary to include the term Railway or Railroad. The shortest term to express in a general way the field covered in the design, maintenance, repair and operation of motive power, rolling stock and shop equipment seemed to be covered by the word Mechanical. The words "Railway Mechanical" being incomplete as a title, the selection of a third term became necessary and, literally, hundreds of suggestions were made as to this in the months during which the change has been under consideration. The name decided upon was *Railway Mechanical Engineer*.

This on first thought may meet with a certain amount of criticism, since it is similar to the title of an officer whose duties are confined within comparatively narrow limits. We prefer, however, to consider the term in a broader sense, in that all of the operations in the motive power and car department are included under the broad head of mechanical engineering. Be assured, therefore, that the change in name does not mean the narrowing of our efforts. Indeed our plans for the coming year contemplate the publication of a journal which will be bigger, better and more interesting than ever before.

Certain improvements will be made in our January, 1916, issue which we believe will add much to the attractiveness and value of the paper. Watch for this first issue of the new year. The name will be new, but we hope it will occupy an even greater place in your affections. And, by the way, our circle of friends has enlarged greatly during the past 12 months—an increase of over 74 per cent in paid subscribers—and we hope that it will broaden still more during the coming year. May we also invite your attention to the completeness of the annual index which accompanies this issue and which covers the June Daily issues of the Railway Age Gazette, which are published during the June mechanical conventions and are furnished free to all of our subscribers.

#### Prosperity and the Railways

An era of prosperity is at hand and will be most welcome. The past two years have been depressing, especially so to the railroads, and railway men in general have been sorely tried. The very existence of the railroads is dependent on the prosperity of the country, as the increase in the number of roads passing into the hands of receivers during the past few years may well indicate and, on the other hand, the existence of prosperity is in a large measure dependent on the railroads. A boom in business means that the railways will be called upon to transport large quantities of freight. Without the necessary equipment to handle this freight the continuance of prosperity is going to be severely handicapped, and this is one

of the most serious problems confronting the railways to-day.

It is estimated roughly that all the railways in this country require approximately 150,000 new freight cars a year to keep their equipment up to standard. In 1914 only 80,264 were ordered and so far this year our records show that only 85,000 have been ordered, which makes a deficit of about 120,000 cars. To complicate matters still further, the question of delivery of those cars recently ordered and those that will be ordered in the near future, is a very serious one.

It has been stated by a vice-president of one of the largest car building companies in the country that, on account of the suddenly increased demands for steel products and the large amount of unfilled orders reported by the steel companies, more than one-third of the steel required for car contracts now placed will not be delivered until after July 1, 1916, and that little or no equipment ordered after January 1, 1916, can be completed before the close of that year. In view of these conditions, the railways, during the next year, are liable to be placed in an embarrassing position from a shortage of cars. In addition to this, the prices for equipment have been increased anywhere from 15 to 25 per cent in the last six months.

That strenuous steps should be taken to prevent the recurrence of such a notorious car shortage as occurred in 1907, and which so irritated public opinion, should be readily apparent. With the steel market thoroughly congested, there seems but one alternative left for the railways to follow and that is an active and determined effort to place those cars they already have in first-class condition. According to the last reports, June, 1914, there were about 8.6 per cent of the freight cars in shops undergoing repairs, and, considering the financial stringency since then, the percentage at the present time cannot be far from 10 per cent. By increasing the car shop forces for the purpose of putting these cars in service, and following a systematic campaign to repair defective equipment, it is believed possible to bring the percentage of cars in shops down to 5 or even 4 per cent. This would mean that the number of cars available for service would be increased some 135,000 or 160,000, which would do much toward alleviating a shortage. In view of the present relatively high cost of equipment and with a possible still further increase, this plan may also prove to be a profitable financial expedient. In all events, it should be seriously considered, as a recurrence of a serious car shortage is sure to tear down much of the constructive work that has been done in the past few years in influencing public opinion in favor of the railroads.

#### NEW BOOKS

*Electric Railway Handbook*. By Albert S. Richey, consulting engineer, and professor of electric railway engineering, Worcester Polytechnic Institute, Worcester, Mass., assisted by William G. Greenough. Bound in leather. 817 pages, 4 in. by 6½ in. Illustrated and indexed. Published by the McGraw-Hill Book Company, Inc., 239 West 39th street, New York. Price \$4.00.

This is the first edition of a book of pocket size in which the aim has been to get together in compact and usable form a large amount of information which the electric railway engineer frequently requires but often finds only after an extended search through mechanical, electrical or civil engineers' handbooks or the files of technical journals. It is divided into eleven sections, section one dealing with roadbed and track; section two with buildings; section three with train movements; section four with railway motors; section five with controlling apparatus; section six with current collecting devices; section seven with trucks; section eight with braking; section nine with rolling stock; section ten with transmission and distribution, and section eleven with signals and communications. The book is printed on thin paper, the typographical work is excellent, and illustrations are liberally employed. It is a book which should prove of more than ordinary value in electric railway work.

# SWISS RAILWAYS DYNAMOMETER CAR

Equipment Includes Dynamometer and Ergometer  
Integrators and Integrating Cylinder Indicators

BY H. A. GAUDY

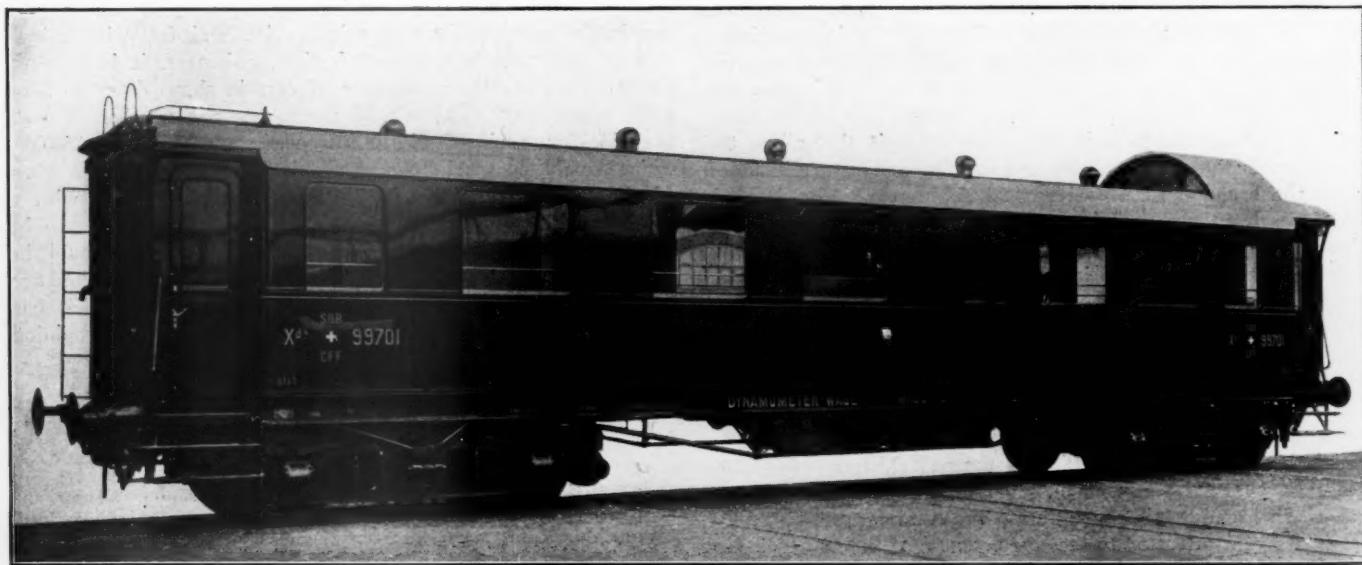
Mechanical Engineer, Swiss Federal Railways, Berne, Switzerland

As a result of the large amount of rolling stock purchased in the last few years and the continuing progress made in the improvement of the steam locomotive, dynamometer cars have come into extensive use on the principal European railways, thus enabling by the results obtained accurate decisions to be made on questions relating to economical train operation. The need of reliable measuring instruments for use in conducting tests was recognized by the management of the Swiss Federal Railways, and accordingly it was decided to secure a suitable dynamometer car.

The designs were prepared in the office of the chief mechanical engineer after a thorough study of all the principal questions involved in the selection of the type and general arrangement to be adopted as well as the apparatus and instruments required. The car proper was built by the Swiss Industrial Company, Neuhausen, and orders were placed for the equipment with Amsler Brothers, Schaffhausen, a firm noted throughout the world for the manufacture of scientific instruments. The car was delivered late in 1914 and embodies a testing laboratory equipped with the most modern instruments, measuring apparatus and auxiliary devices yet applied to a vehicle of this

first one with a length of 13 ft. 1 $\frac{1}{2}$  in. serves as a working office and recreation room. Upholstered leather-covered seats, movable armchairs and a spacious extension table make up the equipment of this room. A short aisle leads to the back platform, giving access to a small toolroom with an outfit enabling the making of small running repairs, and two lockers for supplies. Adjoining the tool room is a lavatory and toilet room. Owing to the comparatively short main lines of the Swiss railway system there was no necessity to arrange for living accommodations in the car itself, thus reducing the number of rooms required to a minimum and enabling the length of the car to be kept within reasonable limits. The car has closed vestibule platforms in accordance with the standard through car design, and the inside finish is very simple.

Electricity is used for the lighting, a storage battery and an axle-driven dynamo being provided for this purpose. The car is heated by steam taken from the locomotive; it was not considered necessary to provide an independent heating device. The Westinghouse automatic and non-automatic quick action air brake acts on the wheels of three axles only, the rear axle of the forward truck being left free from brake shoes because the



Dynamometer Car for the Swiss Federal Railways

kind, the design being intended to meet all the requirements of road tests of the efficiency of locomotives, the resistance of cars or trains of different kinds, and the amount of power required for the propulsion of trains on certain lines under different running conditions.

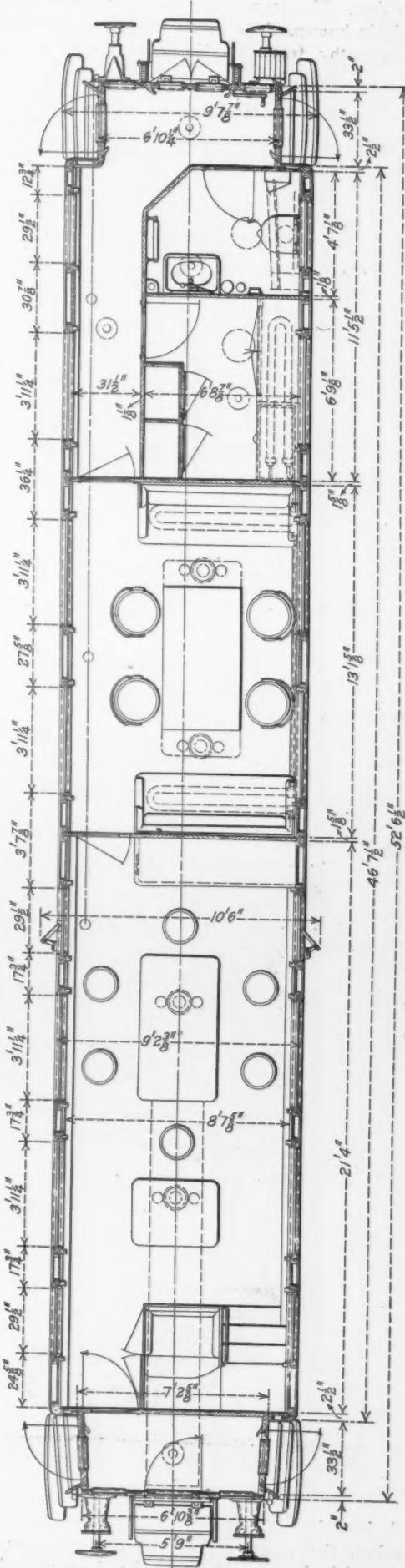
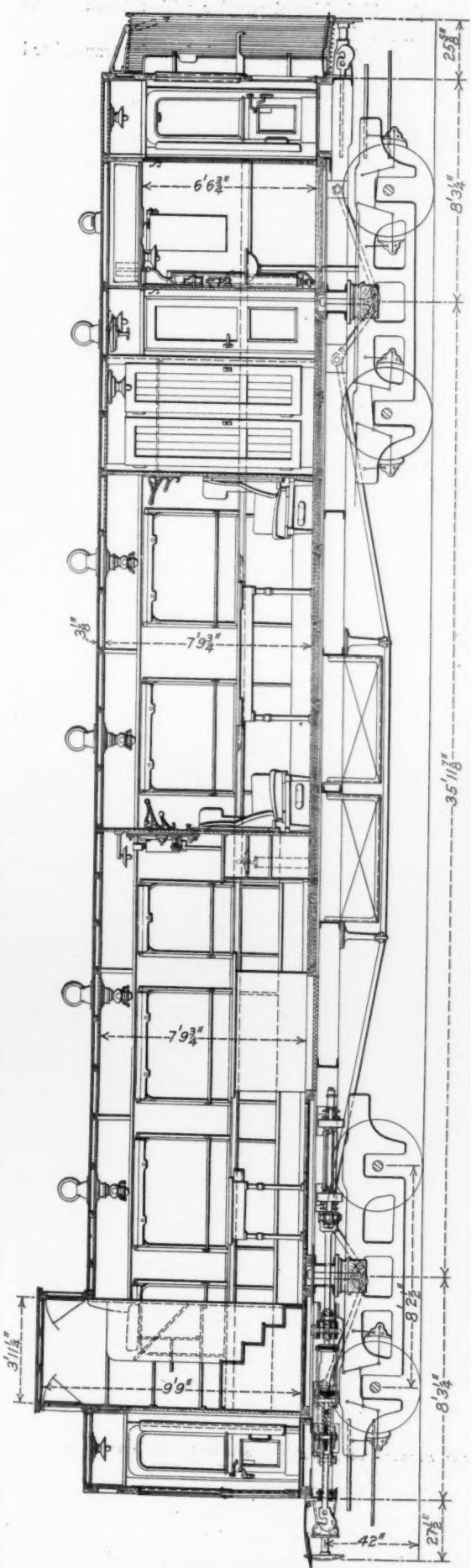
The car body rests on two four-wheel trucks of the railway's standard type. The underframe is made entirely of steel and is of a very strong design. The longitudinal side sills are arranged double in accordance with the extraordinary conditions to be met with in service. The interior of the car is divided into four compartments. The first room at the dynamometer end is the test room, 21 ft. 4 in. in length, where all the measuring apparatus is located. A cupola with an elevated seat just back of the front vestibule permits a good view towards the signals and the track ahead, as well as over the train behind and into the engine cab. A second compartment adjoining the

paper driving mechanism and other apparatus receive their motion from this axle.

The car measures 57 feet over all and weighs 82,000 lb. when in full working order. The width has been limited to 9 ft. 2 $\frac{1}{2}$  in. instead of the standard 10 ft. This was done in order to permit the attachment of mirrors outside of the car, giving a view of the road ahead from the observer's station near the instrument table.

## DYNAMOMETER

Although nearly all European dynamometer cars are equipped with spring dynamometers, either plate or helical, it was decided by the builders to use the hydraulic principle in the Swiss car, because of the fact that with increasing capacity spring dynamometers were growing very cumbersome as well as because of the difficulty of examining and recalibrating the springs from time

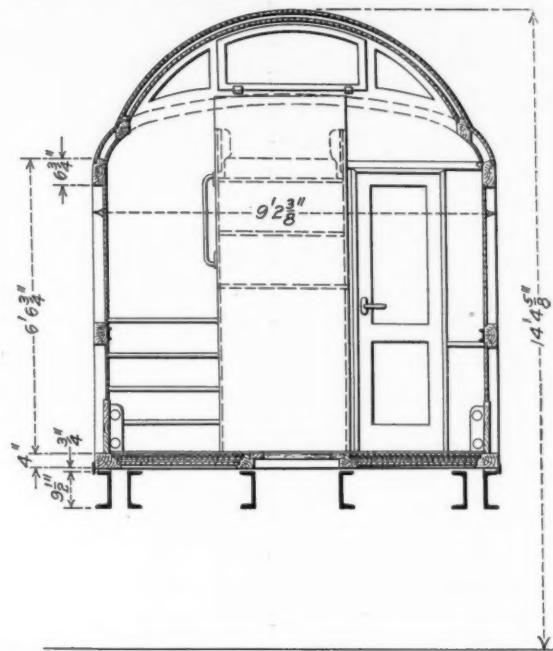
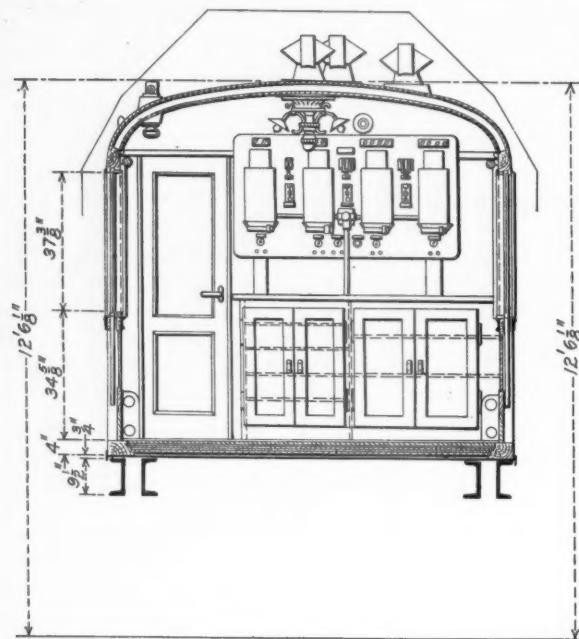


## Sectional Plan and Elevation of Swiss Dynamometer Car

to time. The general principle of the hydraulic dynamometer is widely known. The Swiss apparatus, however, embodies some noteworthy features. No other means are provided to pack

gage all still use the old-fashioned coupler with a hook in the center and buffers on the sides.

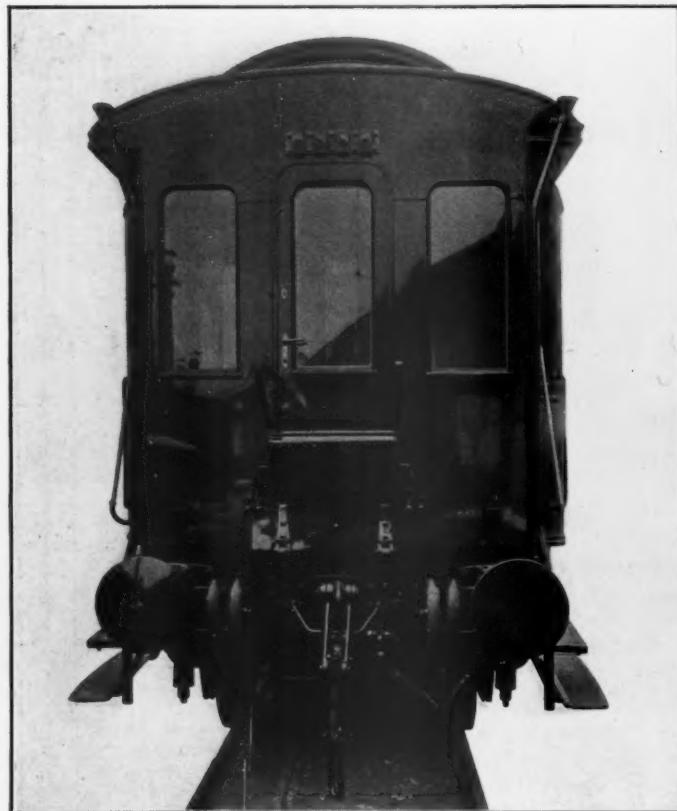
The pressure in the dynamometer cylinders is transmitted



Sections Through the Car Body

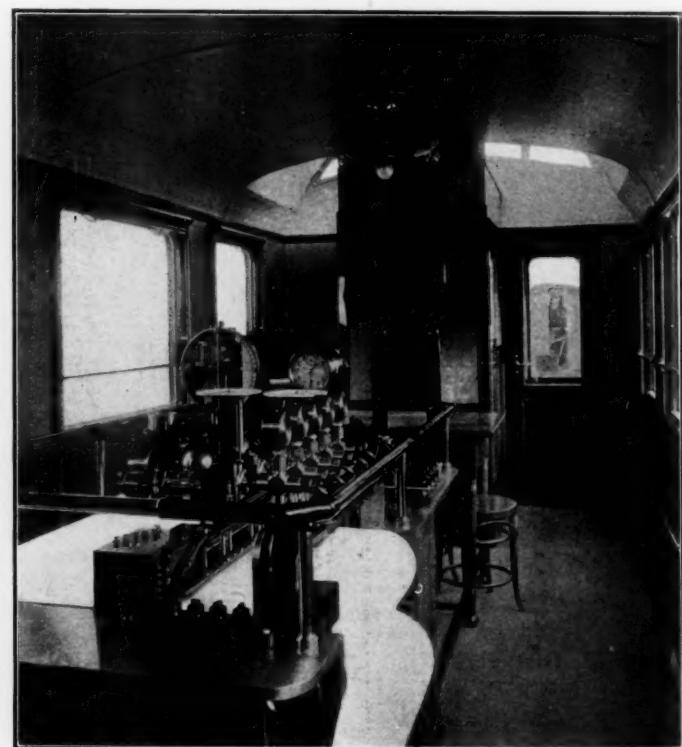
the pistons in the cylinders than simply to grind them in so that a perfect fit is assured with the least amount of frictional resistance. There are two pistons of chilled cast steel extending into two cylinders opening on opposite faces of a single block of forged steel. The pressure exerted on the back piston is

through pipe lines to a pair of smaller recording cylinders, arranged in tandem with the piston ends extending opposite each other and located directly underneath the measuring table. The



Front End of Swiss Dynamometer Car

derived from the pulling effort, while the one in the front receives the reaction from the pressure on the buffers. It should be kept in mind that the European railways of standard



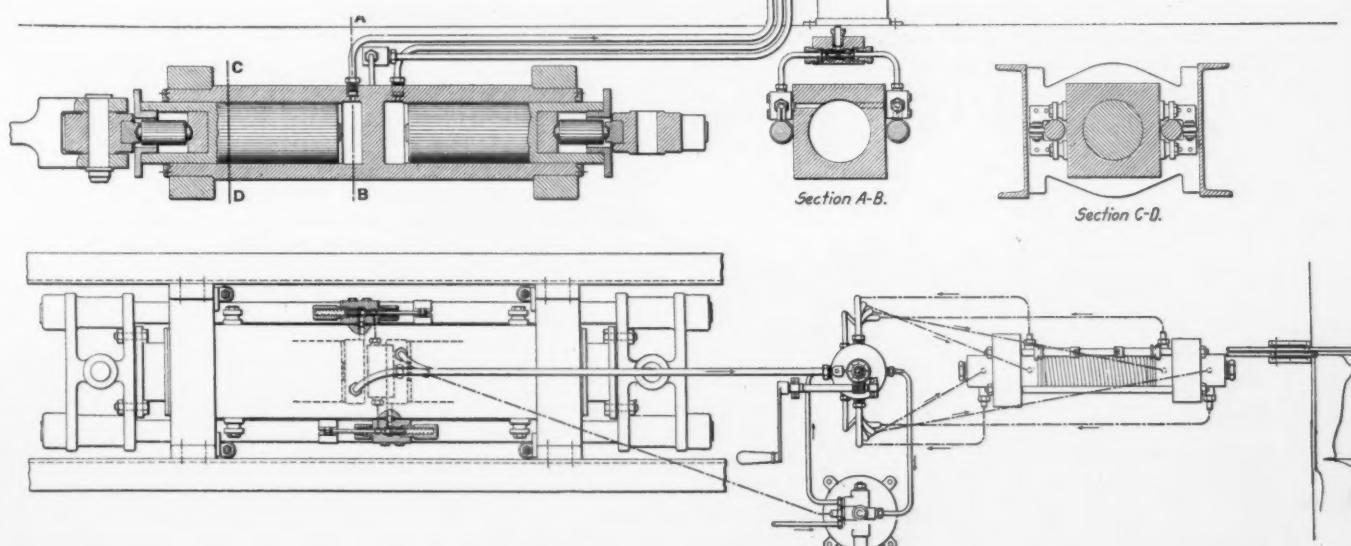
Interior of the Test Room

pressure there acts upon two differential pistons, permitting by means of a distributing valve the use of either one of two areas. A carefully calibrated helical spring is located between the two pistons; its compression indicates the amount of load resting on the small pistons and by knowing the ratios of the areas of these to the ones in the dynamometer proper, we thus are able to determine the load on the drawbar as well as on the buffers.

These differential pistons are so designed that either one-third, one-half or the whole piston area is exposed to the oil pressure. With this arrangement it is possible, by simply turning the distributing valve, to select any one of three scales for measuring the pulling and buffing load, thus keeping the diagrams for heavy trains within a reasonable space on the chart without sacrificing clearness in the diagrams for light trains. There are separate recording pens for the push and pull, attached to the respective ends of the measuring spring. Since only one of them is working at a time the same space is reserved on the paper for the ordinates of both.

In case small leaks should occur in the dynamometer, for instance in the pulling side, the two pistons, rigidly connected with each other by means of yokes and two longitudinal rods, would move away from their central position. It might then happen that, after a long period of pulling exertions, the rear piston would come in touch with the cylinder end, making

The operation of this apparatus is based on the variation in the position of the instantaneous axis of rotation of a sphere about 4 in. in diameter, resting firmly on two disks, the axes of which are perpendicular to each other. One of these disks is turning at a constant rate, driven by a small 1/100-hp. direct



Details of the Dynamometer and Recording Mechanism

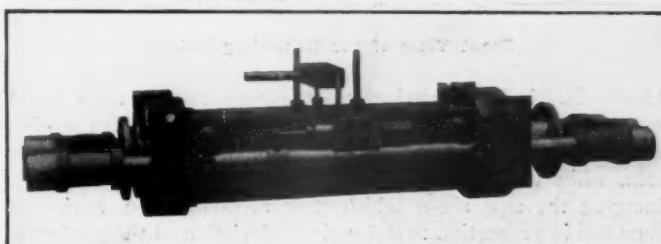
further measurements impossible. A means of equalization has been provided which brings the pistons back to their original positions at the instant the slightest change from a pulling to a buffing action takes place. At this instant an intercepting valve with two check valves produces a connection through a pipe line between the two cylinders, thus equalizing the pressure and permitting the pistons to return to their central position. The check valves close and the by-pass between the cylinders is cut off as soon as the central position is reached. Oil is supplied to that chamber which is increasing its volume from a reservoir under atmospheric pressure; to properly fill all the pipe lines, cylinders and valves with oil before starting the tests, another tank is provided which carries about 50 lb. pressure.

The two buffers at the forward end of the car are connected by means of an equalizing lever, the central pivoting point of which carries the drawbar with its hook projecting beyond the bumper beam. Between this pivoting point and the dynamometer a Westinghouse friction draft gear has been inserted, all the reactions being transmitted through it to the dynamometer. The whole draft rigging is carried on ball bearings in order to prevent undue friction. If the dynamometer is not in service, the draft rigging is locked by means of a heavy pin, connecting it directly with the car underframe.

#### SPEED INDICATORS

The Amsler tachometer, already in use on some of the European dynamometer cars, has been brought to such perfection that it indicates the speed almost instantaneously as a function of the distance covered, differing in fractions of a second only.

current electric motor, while the other has a speed proportional to that of the train. The angle between the axis of the disc rotating at constant speed and the axis of rotation of the sphere thus varies with changes in the speed of the train, the tangent of this angle being proportional to the speed of the train. Two small rollers held in a frame receive their movement from the sphere. They are so located that they always



The Dynamometer, Showing the Intercepting Valve and One of the Check Valves of the Equalizing Device

have their path along its equatorial line, following it with changes in the position of its axis of rotation. Suitable gearing transmits the movement of this frame to a dial, permitting the reading of the speed in kilometers per hour, while a recording pen marks a curve on the paper.

Another speed recorder is installed on the measuring table for the purpose of indicating the speed as a function of the time. The special diagram strip for this purpose moves during stops,

registering the minutes and seconds thus consumed. The records on this paper are not traced but punctured and registration is made every three seconds giving the average speed of the two preceding seconds. This speed recorder works satisfactorily and was years ago adopted as standard equipment for all the road engines of the Swiss Federal Railways.

#### ERGOMETER

This device is designed to measure the work done in overcoming the forces of inertia due to the mass of the train, taking no account of the forces due to air resistance and friction. Its principal part consists of a pendulum suspended underneath the instrument table, oscillating freely in a plane parallel to the center line of the car. If the speed of the train is accelerated, the pendulum, by virtue of its inertia, assumes an angle of deviation back of its middle position, while with the introduction of a retarding effect its position will change in a forward direction. The accelerating and retarding forces are thus determined by the value of the angle given by the varying swing of the pendulum. On an up or down grade this angle is also influenced by the inclination of the track itself, and the weight of the train is considered a force due to inertia.

Let  $P$  = force imparting the movement to the train, except frictional and air resistance.

$M$  = mass of the train.

$X$  = the distance run.

$g$  = acceleration due to gravity.

$\alpha$  = the angle of deviation of the pendulum.

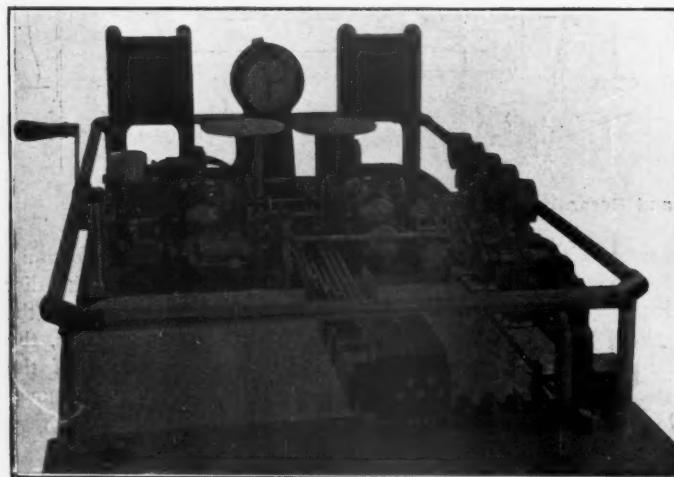
then we have

$$P = M g \tan \alpha$$

and the work to overcome the force  $P$  over the distance  $X$  is

$$A = Mg f \tan \alpha dx$$

This value is computed by a mechanical device designed by



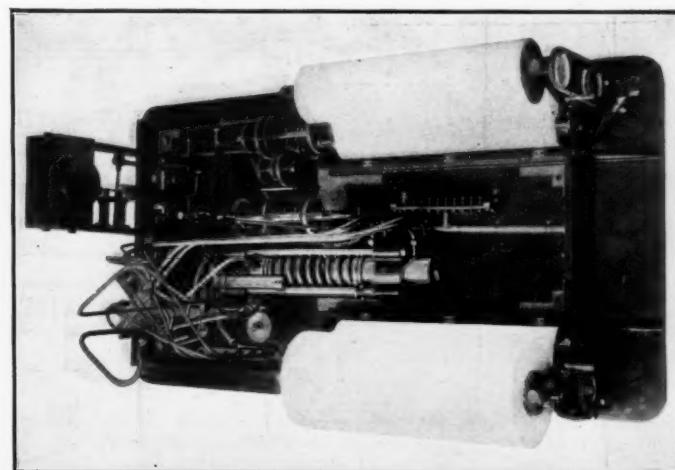
Front View of the Recording Table

Amsler Brothers, consisting of a sphere resting on a small roller, and held in position by two disks. One of the disks receives a turning movement proportional to the speed of the train, while the other is rotated by the sphere itself, the latter changing the axis about which it is revolving in a horizontal plane and in proportion to the angle of deviation of the pendulum. The disk driven by the sphere transmits its movement to a reciprocating bevel gear and thence to a pen on the recording paper. The ordinates of the curve drawn represent the amount of work  $A$ , while another pen suitably connected records the swing of the pendulum, giving ordinates showing the force  $P$ . A reciprocating or switch-back mechanism keeps the curve within the limits of the space reserved on the paper; when the ordinates have reached the limit line the pen will return to the lower limit, thus forming a zig-zag line. Turning points, however, may show anywhere between the limit lines if, for instance, a change in the track profile, or the beginning of the braking process takes place.

This whole device has proved to be very satisfactory and useful. From the data thus obtained together with that obtained from the dynamometer the average resistance per ton of train on a horizontal track and for any speed can easily be determined. And, furthermore, if we know the indicated horsepower of the locomotive we are also able to work out the total resistance of engine and tender on the same section of line. Instead of calculating with lengthy and doubtful formulas we have a very reliable method of measurement.

#### INTEGRATING CYLINDER INDICATORS

To determine the power developed in the cylinders of the locomotive, much difficulty arises on account of the relatively small number of diagrams which can be taken during a test with an ordinary indicator. For a given test run the average indicated power could be calculated only approximately. An important innovation in the form of an integrating indicator has



The Under Side of the Recording Table

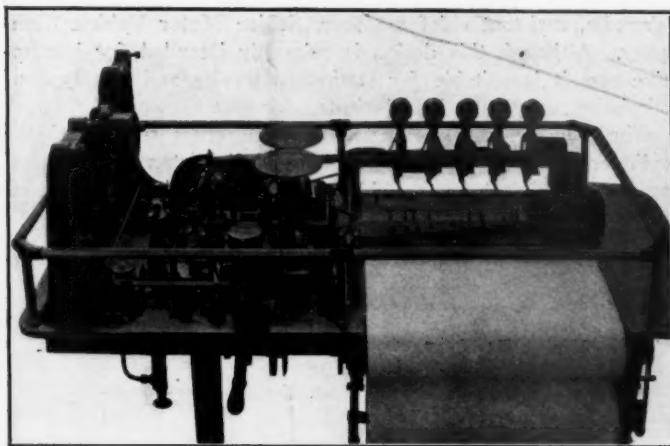
been designed which makes possible the registering of the work done in every cylinder cycle. This device consists of an ordinary outside spring indicator to the end of the piston rod of which is connected a lever rigging. This is attached to a small disc which rests upon the top of the paper drum, being held in contact with it by a spring. Any increase or decrease of steam pressure in the locomotive cylinder results in a corresponding radial displacement of the disc on the end of the drum, the distance from the drum center being proportional to the pressure in the cylinder. The oscillation of the drum about its axis through the action of the reducing motion induces a rotation of the disc, which varies in amount with its distance from the drum center. The rotation of the disc is transmitted to a counting apparatus. From the difference in readings of the counter at the beginning and end of any period of time the mean indicated horsepower for that period may be readily computed. As it is a difficult task to take readings from the counters mounted directly on the indicators an attachment has been added to the device permitting the transmission of all the values to a receiving apparatus similar to the one on the engine, but located in the car, by means of electric contacts. This arrangement makes possible the determination of the indicated horsepower over any distance of the line under any condition of weather, time, etc. Beside the receiver there are magnet pens which make marks on the recording paper from which the horsepower may be computed in the manner outlined above. Provisions are made for four indicators of this type, thus permitting the complete determination of the power on one side of four-cylinder balanced compound engines.

#### OTHER INSTRUMENTS

The measurement and recording of the work done at the

drawbar in meter-kilograms is done by a device which operates on the same principle as that used with the ergometer. The pen marks a curve whose ordinates are proportional to  $A = P dx$ , where  $P$  represents the instantaneous drawbar pull and  $x$  the distance covered by the train. It also includes a switchback bevel gear transmission mechanism making the curve in a zig-zag form, to keep within space limitations on the paper. Three different scales are available, corresponding with those provided for the dynamometer record. To determine the total work done at the drawbar for a given length of track the number of zig-zags in the curve is multiplied by a constant the value of which depends upon the scale being used. For a check and to facilitate quickly reading off the values at any time a counter is attached to the apparatus.

The drawbar horsepower is measured by an instrument similar in operation to the Amsler speed recorder, consisting of a constant speed disc from which a sphere is rotated, as well as a



A Side View of the Recording Table

second disc the speed of which is determined by the apparatus used in recording the work done on the drawbar. The horsepower is recorded in the form of a continuous curve to one of three scales, corresponding to the three steps in the load scale.

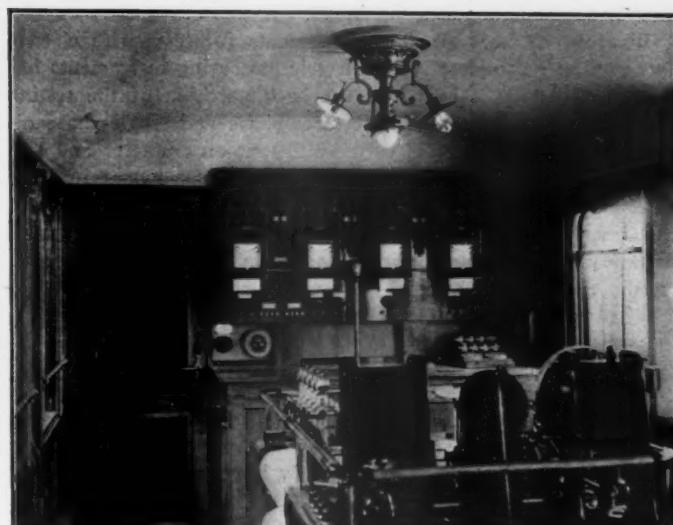
Wind resistance is measured by a device based on the principle of the Pitot tube. There are two tubes extending about 30 in. over the top of the roof near the rear end of the car, the upper ends of which are bent at right angles, the opening of the front one pointing forward and the other backward. These tubes are in communication with a receiver underneath the instrument table, which consists of two hollow cylinders about 8 in. in diameter carried on the ends of an equalizing lever. One end of each cylinder is open and two vessels of ring section filled with mercury are provided, in which these ends are submerged. When the train is in motion air enters the forward tube and effects an increase in air pressure in its cylinder while in the other one the pressure is decreased. Equilibrium is thus destroyed and the equalizing lever inclines against the side of less pressure. This movement is transmitted by means of a small rod passing through the table and acting upon a calibrated indicator spring, to which a recording pen is attached. This is a newly developed device and it has yet to be thoroughly tried out. However, the indications are that it will be possible to determine a proportion between the ordinates of the recording pen and the component of wind pressure directly in front of the moving train. Experience has shown that vibration and shocks do not affect the stability of the equalizing lever and that any movement of this rigging is caused only by the difference of air pressure in the tubes.

For the close investigation of brake performance Kapteyn apparatus has been in extensive use. This has undergone essential modifications in an arrangement designed by Amsler Brothers which is placed on the recording table adjoining the

other instruments. The radial and tangential forces resulting from the action of the brake shoes against the wheels are measured by means of three hydraulic cylinders interposed in the brake rigging. Two of these cylinders form a part of the hangers for the front brake shoes of the forward axle of the front truck and serve to measure the tangential forces, while the third one is placed in the brakerigging at the center of the brake beam and indicates the radial force.

This arrangement can be used for the determination of the coefficient of friction between the wheels and brake shoes in testing the materials of which the brake shoes are made. Three other indicators record the pressures in the brake cylinder, in the train pipe and in the auxiliary reservoir during each braking period. Provisions are also made for an electric contact on the engineer's valve in the engine cab, connected with a special recording device, so the length and the time of stop can easily be measured. The pens of this recording apparatus can be taken off or put into working order at any time desired, so they may be out of the way when not required.

All the apparatus and registering devices are mounted on a cast iron recording table firmly secured to the car underframe. All the records are made on a continuous chart carried on rolls about 25½ in. in width. The travel of the paper may be regulated to 20, 100 or 600 mm. for each 1,000 meters (1.26, 6.30 or 37.8 in. per mile) and an automatic reversing arrangement causes the paper to run in the same direction whether the car is running



A View of the Recording Apparatus for Electric Traction

backward or forward. During brake tests the paper travel may be at the rates of 1 mm., 5 mm. or 30 mm. per second.

Magnets control seven electric pens, two of which are marking the minutes and each 1.3 or 6 seconds; the third one is the distance pen for each kilometer traveled and for marks due to passing of stations and other points on the line; the last four pens are reserved for recording the values from the integrating steam indicators.

The motion derived from the rear axle of the front truck, which serves for all the apparatus needing a movement proportional to the travel of the car, is transmitted from the axle to the main drive underneath the table by means of a spur gear and a small pinion connected to a flexible shaft. The amount of power transmitted being very small and resistance being reduced to a minimum by ball bearings, the installation of a complicated and heavy worm gear device could be dispensed with. The pinion is held on the spurwheel by a torsional spring, and may be lifted to cut off the transmission gear when no tests are being made.

The wheel tires are of standard tread. The error originating

from the non-preventable tire wear can be compensated by replacing the spurwheel mounted on the axle with others having a smaller number of teeth. Provisions are made for spare gears for each decrease of about 10 mm. in car wheel diameter.

There are two groups of recording pens, each arranged in one line perpendicular to the path of the paper. The measurements which can be recorded are given below:

#### GROUP I.

Speed in kilometers per hour.  
Inertia force in kilograms per ton; positive and negative.  
Buffing reaction in kilograms.  
Pulling reaction in kilograms.  
Drawbar horsepower.  
Work to overcome forces due to inertia, in meter-kilograms.  
Work on the drawbar in meter-kilograms.  
1.3 or 6 seconds, magnet contacts.  
1 minute contacts.  
Distance marks, kilometers, stations, etc.  
Indicated horsepower, high pressure cylinder, front.  
Indicated horsepower, high pressure cylinder, back.  
Indicated horsepower, low pressure cylinder, front.  
Indicated horsepower, low pressure cylinder, back.

#### GROUP II.

Length of stop, meters.  
1.3 or 6 seconds, magnet contacts.  
Air pressure, auxiliary reservoir.  
Air pressure, train line.  
Air pressure, brake cylinder.  
Radial force on brake shoe.  
Tangential force on brake shoe.  
Wind pressure.

There are eight other pens for the different zero lines in the first group, making 30 pens in all.

In order to meet all the requirements for tests with electric locomotives a complete set of electric measuring instruments has been installed on a board on the back partition of the testing room. This apparatus, to suit three-phase and single-phase alternating current, consists of a voltmeter, an ammeter and two wattmeters, recording in straight line ordinates by means of a sparking device. The paper in this apparatus is moved at the same rate of speed as that on the recording table, thus permitting an easy and quick comparison of the data recorded on the two sheets.

## FAILURE OF FUSIBLE TIN BOILER PLUGS

An investigation into the failure and deterioration of fusible tin boiler plugs in service has recently been conducted by G. K. Burgess, physicist, and P. D. Mercia, assistant physicist, of the United States Bureau of Standards. In some cases such plugs have failed to melt and so give warning of dangerous boiler conditions, and investigation has shown that the tin filling in these cases had become oxidized, the tin oxide having a melting point above 2,900 deg. F.

One pronounced and dangerous type of deterioration is the oxidation of the tin along the grain boundaries, by which is formed a network of oxide throughout the tin. The plugs showing deterioration of this type all came from the same manufacturer and contained zinc in amounts varying from 0.3 per cent to 4.0 per cent. It is shown that this type of oxidation is due to the presence of the zinc. The latter metal is not soluble in the solid state in tin, and when a tin with small amounts of zinc is heated as in a boiler to about 340 deg. F. the zinc coalesces as a network enveloping the tin crystals or grains. The boiler water, particularly if it contains alkali, will attack the zinc, eating its way into the alloy along the zinc network, and finally form the oxide network described.

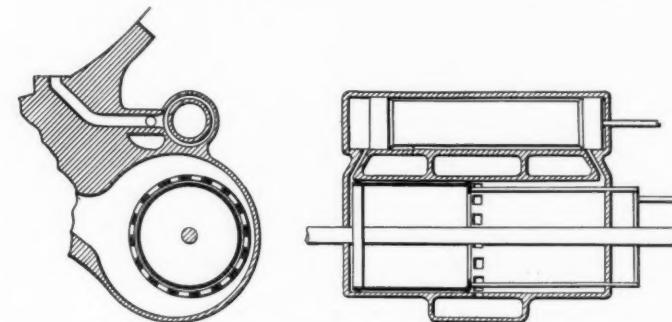
Lead and zinc are found to be the principal impurities in tin plug fillings, and since all failed plugs contained these or other impurities the conclusion is reached that if these impurities are eliminated by strict specifications and inspection, which will allow only admittedly superior qualities of tin, the danger of failures of these plugs will no longer exist.

## UNIFLOW CYLINDER FOR LOCOMOTIVES

A number of uniflow engines have been built in this country within the last few years, all of them based on the design developed by Prof. Stumpf of Charlottenberg College, Berlin, Germany. These engines, although showing a phenomenal increase in economy over the old four-valve type, have several inherent defects that have made American engineers slow to adopt them. Among these defects can be mentioned the increased length of cylinders, the use of the heavy block piston and, in the case of a condensing engine, the danger of over compression when the engine loses its vacuum. The first two faults have entirely prevented the consideration of this type of engine for locomotive service.

With the purpose of removing these defects and producing a uniflow engine that would be adaptable to locomotive service, the design shown in the sketch was developed by Prof. H. A. Stringfellow, Mechanics Institute, Rochester, N. Y., and E. W. Templin, assistant chief engineer, Selden Motor Vehicle Company. Although this design is primarily intended for locomotive use, it is suitable for stationary service and any type of admission valve may be substituted for that shown.

The sketch shows a longitudinal and cross section of the cylinder. Instead of using the long block piston to open and cover the exhaust ports, a blank sleeve is used, the length of



Proposed Design of Uniflow Cylinder for Locomotives

this sleeve being equal to one-half the stroke less the width of the exhaust port. The outside of this sleeve is provided with packing rings to make it steam-tight in the cylinder and reduce the sliding surface. The piston travels within the sleeve, both traveling in the same direction, and as the speed of the sleeve is approximately one-half the speed of the piston, the latter never runs outside of the sleeve. The sleeve may be driven from an eccentric, or by a rod, from any portion of any standard valve gear that will give the desired speed and motion. The sketch shows the use of two rods connected by a yoke outside the cylinder, as the means of transmitting motion to the sleeve. As it travels in the same direction as the piston, the steam pressure acting on what little end area is exposed is almost sufficient to drive it, thus relieving the valve gear from any great increase in work.

The exhaust port is placed at the middle of the stroke and not at the end as in present engines of the uniflow type. Because of this location and the use of the sleeve, this engine will show a later point of release than the usual uniflow engine, a release as late as 92 per cent. of the stroke being easily attainable. The cylinder is also more completely freed of the expanded steam, thus materially reducing the amount of clearance required. Any point of release from 92 per cent to 100 per cent may be obtained by varying the amount of lead the piston is given over the sleeve. When the sleeve is set as shown in the sketch so that the piston has no lead the engine may be reversed without moving the sleeve, but if lead is given to the piston the sleeve must be moved back a distance equal to twice this lead in reversing. This can be done by attaching the sleeve operating rod to a block in a link on the combination lever at the point

from which the sleeve is driven, and raising or lowering this block, as the case may be, by a suitable connection from the reach rod. The amount of release can be changed by simply setting the sleeve as a slide valve is set. The most economical point of release can only be determined by experiment.

## SOUTHERN STEAM TENDER LOCOMOTIVE

BY HUGH G. BOUTELL

About 1863 Archibald Sturrock of the Great Northern Railway of England brought out a class of six-coupled goods locomotives with what he called a "steam tender." The tender was really a small locomotive with cylinders 12 in. by 17 in., and the weight with an average amount of fuel and water was about 37 tons. Steam was taken from the boiler of the main engine, which was larger than usual, and the exhaust, after passing through a heater in the tank, escaped to the atmosphere. The writer has never seen an accurate report of the performance of these engines, but it is understood that they showed great hauling capacity as compared with the ordinary freight engines in use at that time. However, as the tender, like the main engine, was inside-connected, it must have been difficult to make running repairs, and the working parts must have picked up a great deal of dirt from the locomotive and roadbed.

The Erie triplex locomotive recently built by the Baldwin

to lubricate the cylinders, but when a heavy grade is reached it may be opened to any desired amount. The exhaust passes to the atmosphere through the vertical pipe at the rear of the tank.

This engine is regarded only as an experiment, but its service so far is understood to have been entirely satisfactory and the construction of a similar machine, using the running gear of small consolidation locomotive, is under consideration.

The principal dimensions of the engine now in service are as follows:

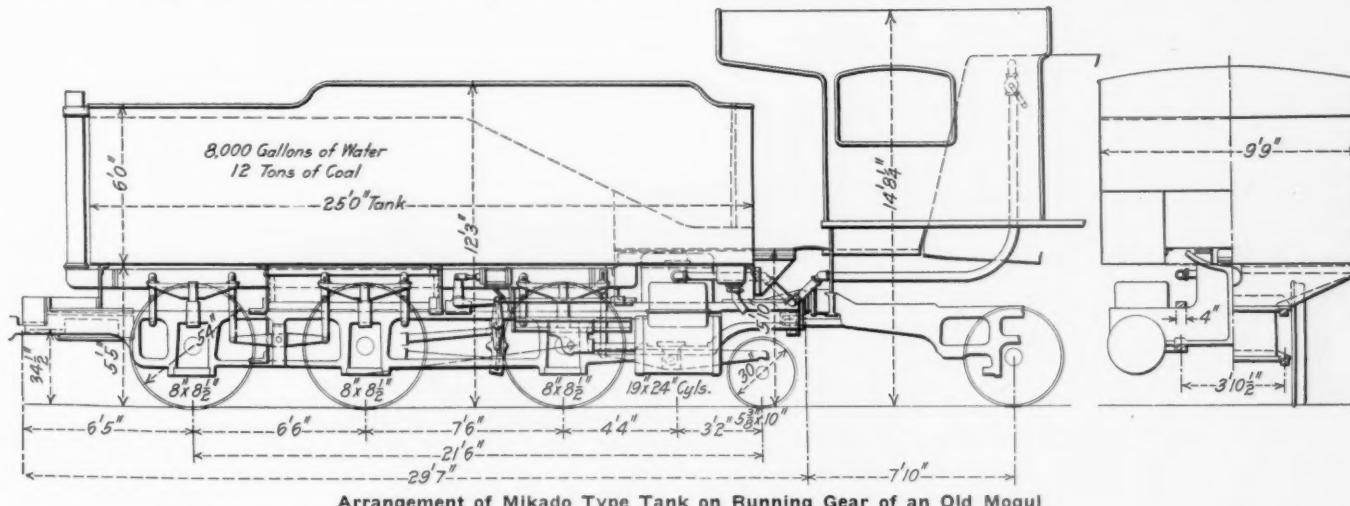
	Main engine	Steam tender
Cylinders	27 in. by 30 in.	19 in. by 24 in.
Drivers, diameter	.63 in.	.54 in.
Weight on drivers	215,700 lb.	124,000 lb.
Total weight	272,940 lb.	152,700 lb.
Steam pressure	175 lb.	.....
Water capacity of tank	.....	8,000 gal.

## SOUTHERN PACIFIC SIX-VOLT ELECTRIC HEADLIGHT EQUIPMENT

BY A. H. BABCOCK

Consulting Electrical Engineer, Southern Pacific Company, San Francisco, Cal.

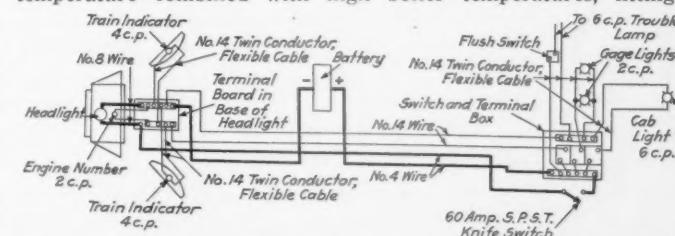
About a year and a half ago the Pacific System of the Southern Pacific Company replaced all its acetylene headlights with incandescent lamps of the automobile headlight type, but of larger size. The idea of automobile lighting was carried throughout the entire installation, even to the fittings employed in the



Locomotive Works may be regarded as a direct development from these early English engines, but still more recently the Southern Railway has designed an auxiliary tender that embodies exactly the same ideas as Sturrock's engines of the '60's. The arrangement consists of a steam tender applied to a Mikado type freight locomotive. The engines of this class had shown themselves to be such free steamers that the management concluded that two more cylinders could be supplied, at least for short periods. There are many conditions which may cause a train to stall when there is ample steam to keep it moving. Anything that will cause slipping on heavy grades may do so when there is not only steam but ample cylinder power as well. It is in such situations as this that the steam tender comes into play by increasing both the cylinder power and the adhesion. It really acts as a helper, but has the advantage of being on hand whenever it is needed.

A general conception of the construction of the machine may be obtained from the drawing. The boiler was removed from a small Rogers mogul locomotive and the tank of the Mikado engine placed on the frames, a few alterations having first been made in the tank to enable it to fit over the cylinder saddle. Steam is supplied to the tank cylinders through a flexible pipe connection by an independent throttle valve in the cab. Under normal running conditions this valve is opened merely enough

cabs and to a portable trouble lamp on a long cord, to take the place of the old smoking torch. One of the illustrations shows the type of automobile light fittings that in practice has been found satisfactory, except that under extreme summer desert temperature combined with high boiler temperatures, fittings

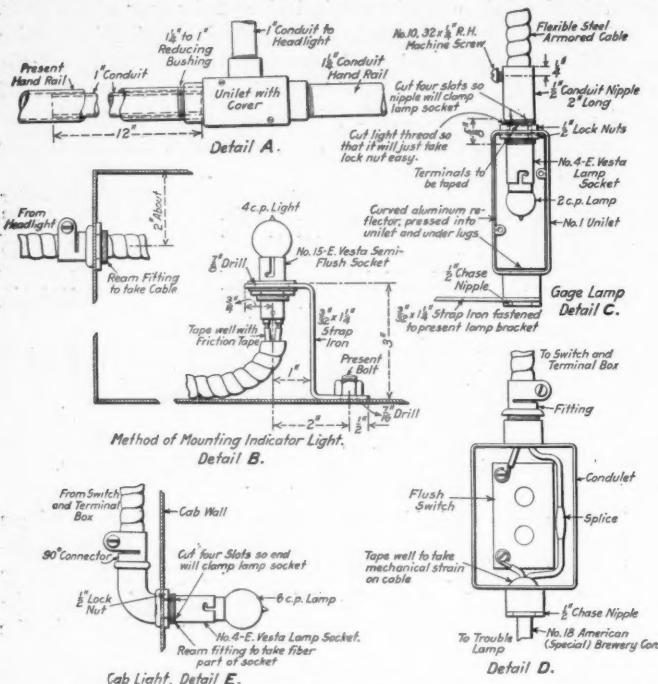


that are made of moulded rubber, or its equivalent, have softened. These are now being replaced with vitrified fittings.

In placing the lamps, particularly those in the cab, the principle followed has been to direct the necessary amount of light upon the spot where it is needed and to cut off all extraneous light, with the result that very small lamps give entirely satisfactory illumination and the sensitiveness of the engine crew's eyes is not diminished unnecessarily.

There are now 900 of these headlights in service and their

performance has been remarkable. The old acetylene or arc headlight reflector can be used by simply covering the openings.



Details of Automobile Fittings Used in Southern Pacific Electric Headlight Installation

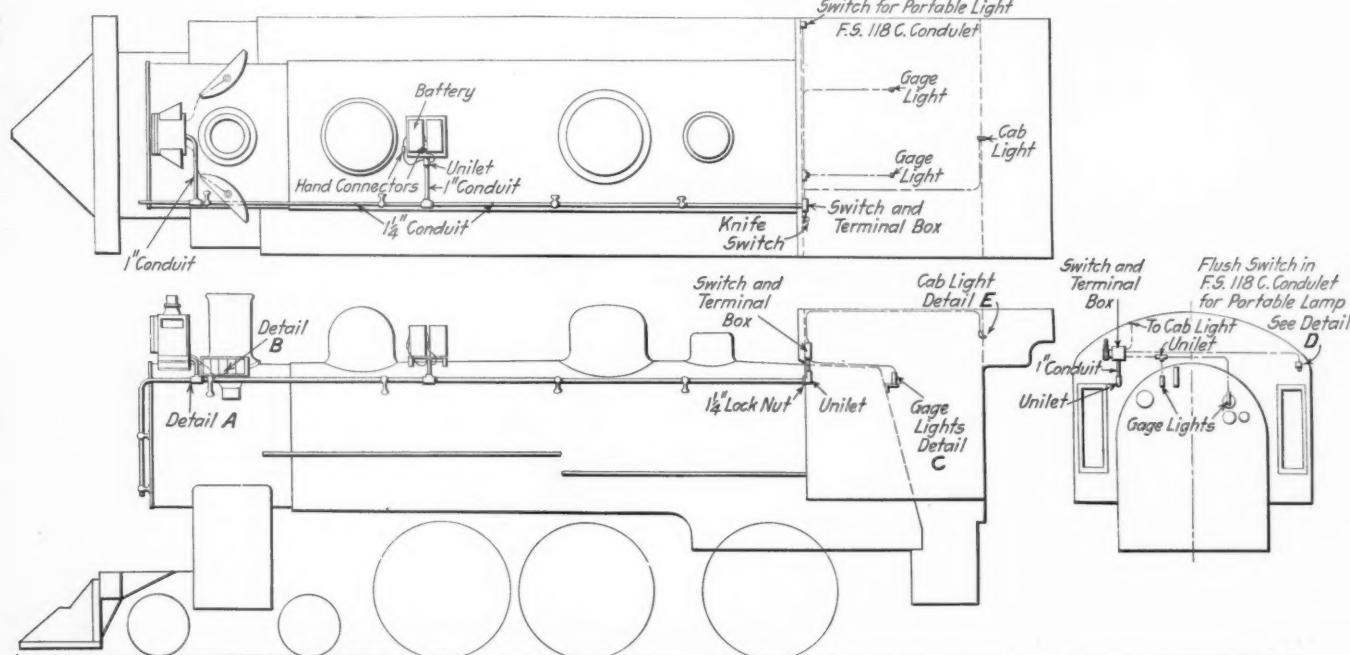
A new opening should be cut in the vertex of the reflector and the incandescent lamp, with its focusing device, inserted from

flickering or jumping of the light, as is the ordinary experience with the arc headlight; and, furthermore, while the arc lamp has a mean spherical candle-power intensity of from 800 to 900 candles, according to conditions of the lamp and length of arc, its beam candle-power, with the same reflector is only 165,000.

Certain manufacturers of 32-volt arc headlight outfits are using 32-volt incandescent lamps, burned up to 37 volts, in the same reflectors in the hope of securing equal illumination by forcing the candle-power. On account of the necessity of the longer filament in the 32-volt lamp, this hope cannot be realized; in fact, tests show that even under these conditions the beam candle-power is less than one-half that of the six-volt lamp. Furthermore, the steam consumption of the turbo generators designed for arc headlight purposes is from 250 to 450 lb. per hour, while that of the most recent six-volt turbo generator for cab lighting is less than 50 lb. of steam per hour, and the cost of installation is slightly in favor of the six-volt outfit.

The portable trouble lamp was hung convenient to the engineman's head and by it he read his train orders, until it became evident that the portable light was also convenient around automobiles, of which our enginemen seem to have many. In fact, the practical results indicate that they found the trouble lamps more useful in the automobiles than in the engine, with the result that the trouble lamp is now being replaced with a fixed lamp over the engineman's head with a switch convenient to his head.

For the reason that these installations were somewhat rushed, owing to legal requirements, there was not sufficient time to develop a suitable electric generator, and it was necessary to use a battery, with stationary charging stations at the locomotive turning points, where the locomotives leave their exhausted



General Arrangement of Six-Volt Electric Headlight Installation, Southern Pacific

the rear. Lamps for six-volt circuits, especially in the sizes used for headlight purposes (108 watts) have filaments very strong and heavy, consequently they can be wound into an exceedingly small cylinder not more than  $\frac{1}{8}$  in. in diameter by  $\frac{1}{8}$  in. long. This can be placed very accurately in the focus of the reflector, and the result is a concentrated beam of light of very great penetration, the beam candle-power measuring approximately 1,046,000, while the mean spherical candle-power of the lamp itself is only 140. On the other hand, if a wide beam of less power is needed, as for example on crooked track in the mountains, an adjustment of the focus brings about this result. There is no

batteries and take full batteries, just as they take their supplies of sand, lubricant and water.

**AMERICAN STEEL TO GREAT BRITAIN.**—Great Britain's imports of blooms, billets and slabs from the United States in August were 44,059 gross tons, against 471 tons in August, 1914. For the eight months to Sept. 1, 1915, they were 252,330 tons, compared with only 21,357 tons to Sept. 1, 1914. For the 13 months of the war, from Aug. 1, 1914, to Sept. 1, 1915, total imports from the United States were 261,672 tons, against 24,230 tons for the same period a year previous.—*The Iron Age*.

# THE MIKADO VS. THE CONSOLIDATION

## A Study to Determine the Economical Distribution of Power from a Net Revenue Standpoint

BY N. D. BALLANTINE  
Assistant to Chief Operating Officer, Rock Island Lines

For the purpose of determining the relative merits of the Mikado and Consolidation locomotives on certain divisions of the Rock Island, a study was made under practical operating conditions, which showed, among other things, where a given number of locomotives of each type could be used to the best advantage from a net operating revenue standpoint. The month selected for the study was during a period of heaviest traffic, when there was a constant demand for power; the data was tabulated subsequent to the performance, and none of the division officials knew that such a study was to be made, hence the freedom from chances for preferential handling of either class of power. The records made currently were tabulated and carefully checked against train sheets, train registers, roundhouse registers, work sheets and fuel tickets. Every practical means was used to secure correct information. There are some apparent discrepancies with respect to the maintenance features, which it is thought were due to the fact that the Mikado locomotives were practically new, there being no question about the expense for heavy repairs made during such a limited time not being as correct a basis as it would be if a year's figures were used. These being the only figures available, they were used, and as they are clearly set out, one can accept or ignore that portion of the study if desired.

The study covers the performance in freight service, other than

show the items in the *direction of traffic* for slow freights; fast freights; combined slow and fast freights; and slow and fast freights on the round-trip basis, the latter figures, for the sake of brevity, being used in this article. None of the divisions on which these locomotives were used have a very large percentage of their traffic of a low grade which will admit being held any considerable length of time for tonnage, the controlling business being made up of merchandise, live stock, packing-house products and perishable freight, which fact makes a study of this nature all the more necessary. The detail information as shown permits a variety of deductions to be drawn directly or by combinations, many of which will be apparent on inspection; a few of them will be pointed out, however.

Table A shows the locomotive utilization, and it is interesting to note the variation in the mechanical department detention on the various divisions. On three divisions it was less for the Mikados, and on the other division, where most of the Mikados were located, it was considerably more, averaging for all divisions 45 minutes more than for the Consolidations. The terminal delay varied from 3 hrs. 11 min. to 7 hrs. 34 min., depending on local conditions; but it is interesting to note that on the division where the greatest volume of traffic was moving, the terminal delay was the lowest for both classes of engines. The time between terminals varied from 7 hrs. 6 min. to 10 hrs. 6

TABLE A—LOCOMOTIVE UTILIZATION, OR A TIME STUDY SHOWING DAILY AND OTHER AVERAGES

	Division A	Division B	Division C	Division D	Averages					
Mik.	Cons.	Mik.	Cons.	Mik.	Cons.	Mik.	Cons.			
Time under mechanical department (hr. and min.).....	9-11	9-18	8-54	9-6	10-39	10-43	9-42	8-15	9-53	9-8
Time at terminals (hr. and min.).....	6-42	5-18	7-22	7-18	3-25	3-11	7-12	7-34	5-37	6-8
Time between terminals (hr. and min.).....	8-7	9-24	7-44	7-36	9-56	10-6	7-6	8-11	8-30	8-44
Actually running, hr. and min. ....	5-5	6-6	5-47	5-46	6-25	6-51	5-30	6-23	5-56	6-25
Meeting trains, hr. and min. ....	1-31	1-46	1-6	0-55	1-30	1-25	0-58	0-56	1-16	1-9
Station work, hr. and min. ....	0-21	0-37	0-38	0-34	1-6	0-49	0-23	0-33	0-40	0-38
Track conditions, hr. and min. ....	0-3	0-1	0-2	...	...	0-4	...	0-1	0-1	...
Block signals, hr. and min. ....	0-1	0-1	...	...	0-6	0-4	...	...	0-3	0-2
Engine failures, hr. and min. ....	0-1	...	0-2	0-5	...	...	0-2	0-3	0-2	0-1
Car failures, hr. and min. ....	0-9	0-3	0-5	0-4	0-11	0-4	0-1	0-3	0-7	0-3
Miscellaneous, hr. and min. ....	0-56	0-50	0-4	0-12	0-38	0-53	0-12	0-12	0-25	0-26
Total time—hours .....	24	24	24	24	24	24	24	24	24	24
Speed between terminals (m. p. h.).....	10.7	11	15.9	18	13.6	14.6	14.5	14.5	14	14.7
Speed actually running (m. p. h.).....	17.1	17.1	21.2	23.6	21.2	21.7	18.7	18.6	20.2	20
Delays per 100-train miles, meeting trains (hr. and min.).....	1-44	1-43	0-53	0-42	1-11	0-57	0-57	0-79	1-36	0-53
Delays per 100-train miles, station work (min.).....	24	34	29	25	45	33	18	27	33	29
Gross ton-miles per day.....	130800	121669	174109	123997	273780	223980	151373	130193	205600	154600
Gross ton-miles per hour (actually running).....	25700	20077	30010	21452	42644	32698	27522	19739	34730	24081

local or way freights and work trains, on four divisions for 31 days of the same month, of 27 Mikado superheater locomotives of 57,000-lb. tractive effort, making 71,000 miles, and 59 Consolidation saturated steam locomotives of 39,000-lb. tractive effort, making 116,275 miles. A total of 262,815,000 gross ton miles was handled, of which the Mikados were responsible for 48 per cent.

No attempt was made to include or compare the expense of maintenance of way and structures, general expenses, supervision, station service, yard service, train supplies, loss and damage and a number of other factors in operating expenses, a variation of which would not be appreciably affected by the class of power handling the traffic. The items included do not purport to represent the total actual cost of handling traffic, but it is thought they include the essential variable items that can practically be located and that are of sufficient importance to justify their inclusion in a study which does not contemplate a degree of refinement in costs to produce figures accurate to the fifth or sixth decimal part of a cent.

In tabulating the data for our own use, it was separated to

min., averaging for all Mikados but 14 min. less per day than for all Consolidations. The actual running time varied from 5 hrs. 5 min. to 6 hrs. 51 min., averaging for all Mikados 29 min. less per day than for the Consolidations. The miles per hour between terminals varied from 10.7 to 18, averaging 14 for the Mikados, or 0.7 m. p. h. less than the Consolidations. The miles per hour when actually running varied from 17.1 to 23.6, averaging 20.2 for the Mikados, or 0.2 m. p. h. more than the Consolidations. The delays per 100 miles, meeting trains, varied from 42 min. for the Consolidations to 1 hr. 44 min. for the Mikados, averaging 1 hr. 36 min. for the Mikados, or 43 min. (equal to 81 per cent) more than for the Consolidations. This fact may or may not be due to longer trains, but as the 43 min. increase is more than 8 per cent of the total time between terminals for the Mikados, its significance should be studied more in detail. The average delay per 100 miles doing station work only varied 4 minutes.

The gross ton-miles per day varied for the Consolidations from 121,669 to 223,980, or 184 per cent, and for the Mikados from 130,800 to 273,780, or 210 per cent, while the average for

all Consolidations was 154,600 and for the Mikados 205,600, or 33 per cent more than the Consolidations. It should be recalled that the Mikados have 46 per cent higher tractive effort. The gross ton-miles per hour when actually running varied for the Consolidations from 20,077 to 32,698, or 63 per cent, and for the Mikados from 25,700 to 42,644, or 66 per cent, while the average for all Consolidations was 24,081, and for the Mikados 34,730, or 44 per cent more than the Consolidations. It should be particularly noted that for the time the engines were *actually running* the increase in ton-miles handled by the Mikados was within 2 per cent of the increase in its tractive effort over the Consolidations, but by referring to the first part of this paragraph it will be noted that when compared on a *daily performance*

basis, had a condition which enabled it to obtain a higher efficiency with the Mikados than on any other division, and this regardless of the fact that it also obtained a higher loading efficiency with the Consolidation locomotives than on any other division. It should be borne in mind that the figures given are for round-trips and an analysis of the figures covering only the *direction of traffic* may produce somewhat different results. In reality, it is *directional* figures which are of the most vital moment to the study, particularly where the traffic is unbalanced to an appreciable degree, high loading efficiency in the direction of traffic being a most significant figure to ascertain.

Table C gives the costs in cents per thousand gross ton-miles for the different items considered in this study. Interest at 6

TABLE B—PHYSICAL DATA

	Division A Mikados	Division B Consols	Division C Mikados	Division D Consols	All Divisions Mikados	All Divisions Consols
Number of engines . . . . .	2	13	4	9	14	15
Engine days . . . . .	50	75	125	111	250	251
Locomotive miles . . . . .	4358	7814	15402	15210	33762	37163
Locomotive miles per day . . . . .	87	104	123	137	135	148
Gross ton miles . . . . .	6544.5	9125.2	21763.7	13763.7	68445	56219.2
Gross tons per train mile . . . . .	1500	1170	1413	904.2	2015	1470
Loading efficiency (per cent) . . . . .	51.3	64.2	76.4	72	62	68.2
Number of trains . . . . .	43	80	123	125	216	229
Average distance run (miles) . . . . .	102	98	125	122	156	162
					119	118
					118	134
					128	

basis, the ton-miles handled is not within 13 per cent of the increase in tractive effort.

Table B indicates by divisions the number of locomotives, locomotive days, mileage and average miles per day, gross ton-miles and gross tons per train-mile, and loading efficiency. It will be noticed from the gross ton-miles produced that there is quite a difference in the volume of business handled on the various divisions; there was also a difference in the class of the traffic. It will be noted that on each division the Mikados made from 13 to 17 miles less per day than the Consolidations, the percentage for all Mikados during the entire period being 7 per cent less. It should also be noted that the division upon which both classes of locomotives made the highest mileage per day was that upon which the length of the average trip was the greatest. The distance between terminals generally has a very

per cent has been figured on the locomotives and cabooses, and depreciation at 5 per cent for the locomotives and 6 per cent for the cabooses. These figures per thousand gross ton-miles vary from 3.1 cents for the Consolidations on Division C, to 6.8 cents for the Mikados on Division D; for all Mikados it amounts to 4.8 cents, or about 12 per cent of the costs enumerated, while for all Consolidations it amounts to 4 cents, or 8.3 per cent of the costs enumerated. Special mention is made of this point for the reason that for certain purposes it is essential to include such items, while for others they probably should not be included; for example, if the question is one dependent on the type of new locomotives to be purchased, or the question of additional locomotives, it manifestly should be included; if, however, it is a question of once having the equipment and of determining the best location for its utilization, interest and depreciation will accrue

TABLE C—PRINCIPAL VARIABLE COSTS PER THOUSAND GROSS TON-MILES IN CENTS

	Division A			Division B			Division C			Division D			All Div.							
	Mik.	Con.	Inc. or Dec.	Mik.	Con.	Inc. or Dec.														
Coal . . . . .	20.3	22.5	-22	9.8	15.4	20.3	-4.9	24.1	11.4	15.6	-4.2	26.9	13.6	18.0	-4.4	24.5	13.0	17.6	-4.6	26.1
Wages, train and engine crew . . . . .	13.5	16.9	-3.4	20.1	13.2	20.9	-7.7	36.5	9.8	12.5	-2.7	21.6	13.4	17.4	-4.0	23.0	11.4	15.8	-4.4	27.8
Roundhouse charges . . . . .	4.0	4.0	..	3.2	3.4	-2	5.9	.2	.2	..	..	3.0	2.7	4.3	11.1	1.5	1.9	-4	21.1	
Water . . . . .	1.5	1.7	-2	11.8	1.3	1.5	-2	13.3	.9	1.2	-3	25.0	1.0	1.4	-4	28.6	1.0	1.3	-3	23.1
Lub. oils and waste . . . . .	.3	.3	..	.2	.3	-1	33.3	.8	1.2	-4	33.3	.3	.3	..	.6	.7	.1	14.3		
Running repairs . . . . .	6.6	2.4	+4.2	143.3	4.0	2.5	+1.5	60.0	2.2	2.1	+1	4.8	5.9	3.5	+2.4	68.6	3.5	2.8	+7	25.0
Classified repairs . . . . .	2.0	3.6	-1.6	44.4	2.1	4.7	-2.6	55.3	1.9	4.0	-2.1	52.7	2.6	4.5	-1.9	42.2	2.1	4.2	-2.1	50.0
Int. on locomotives at 6 per cent . . . . .	3.3	2.4	+9	37.5	2.5	2.3	+2	8.7	2.0	1.6	+4	25.0	3.6	2.5	+1.1	44.0	2.5	2.1	+4	19.0
Int. on cabooses at 6 per cent . . . . .	.1	.1	..	.1	.1	..	.1	10.5	1.6	1.3	+3	23.1	3.0	2.0	+1.0	50.0	2.1	1.7	+4	23.5
Depreciation loco. at 5 per cent . . . . .	2.8	2.0	+8	40.0	2.1	1.9	+2	10.5	1.6	1.3	+3	23.1	3.0	2.0	+1.0	50.0	2.1	1.7	+4	23.5
Depreciation cabooses at 6 per cent . . . . .	.1	.1	..	.1	.1	..	.1	23.3	31.0	39.9	-8.9	22.3	46.6	52.7	-6.1	11.6	38.0	48.3	-10.3	21.3
Totals . . . . .	54.7	56.0	-1.3	2.3	44.7	58.3	-13.6													

important bearing upon the miles per day locomotives make and that it increases with the distance between terminals is to be expected, as it decreases the roundhouse handling and yard terminal delays per 100 miles; hence, the importance of running locomotives through terminals or making turn-arounds if the power is in condition to permit this being done without unduly increasing engine failures.

The gross tons per train-mile for the Mikados varied from 28 to 56 per cent more than that handled by the Consolidations; the average for all divisions is 43 per cent, or about 3 per cent less than the difference in tractive effort, indicating that, as a whole, there was less loading efficiency obtained with Mikados than with the Consolidations.

This is reflected more clearly in the loading efficiency column, which shows that Division B, while having but four locomo-

regardless, and can as well be omitted for purpose of an immediate comparison. It will be noted the costs for the variables listed run from 31 cents for the Mikados on Division C to 54.7 cents on Division A, and for the Consolidations from 39.9 cents on Division C to 58.3 cents on Division B, while for all Mikados it was 38 cents as compared with 48.3 cents for the Consolidations.

A glance at Table A might cause one to feel that the proper place to put the Mikados would be where they would produce the most gross ton-miles per day or hour, in which event it would point to Division C, as on this division they produced 273,790 gross ton-miles per day, or 42,644 gross ton-miles per hour when actually running. What we are trying to determine, however, is whether it is more economical to keep the Mikado on a particular division as opposed to another division. Let us compare

Divisions *B* and *C*. By referring to Table *C* and Division *C* it is noted the cost per 1,000 gross ton-miles is 8.9 cents less for the Mikados than for Consolidations, and as the Mikados produce 273,790 gross ton-miles per day, this is equivalent to their saving \$24.36 per day, while by referring to Division *B*, it will be noted the Mikados save 13.6 cents per 1,000 gross ton-miles, which with the 174,109 gross ton-miles they produce per day, makes a saving of \$23.68, a difference of only 68 cents in favor of Division *C*. As previously referred to, however, the maintenance feature was known to be a little uncertain, and inspection indicates the running and classified repairs on Division *B* was 6.1 cents as against 4.1 cents on Division *C*, or nearly 50 per cent more. With such a wide difference in this item, it would not be unfair to average the two, or eliminate the feature; in either of which events, it will indicate that the greatest saving can be effected on Division *B*.

A knowledge of local conditions is, of course, an advantage in making such an analysis, as in this particular instance it is known that with the volume of traffic moving on Division *B*, and the necessity for protecting local work, it would not be economical to place any more Mikados on that division under present traffic conditions. The above analysis indicates, in this specific case, economy in operation to use a Mikado locomotive on a division where it will not produce within 65 per cent of the ton-miles which it produces on another division, a condition which will doubtless appeal to many as an anomaly.

In this connection there might also be pointed out the relation existing between handling tonnage with large versus small power when the train-mile unit is used. It is frequently considered by some that increasing the size of power and being able to utilize it as efficiently as the smaller power, thus reducing train-miles, will bring about a reduction in expenses equivalent to the cost of a train-mile saved; but that this is a fallacy, can, I think, easily be pointed out from the data contained in the above tables. For example, the costs on Division *A* per 1,000 gross ton-miles for the Mikados were 54.7 cents, the average tons per train were 1,500, therefore the cost per train-mile was 82 cents. The cost for the Consolidations per 1,000 gross ton-miles was 56 cents, the average tons per train was 1,170, therefore the cost per train-mile was 65.5 cents. Here there was an increase of 330 tons in tons per train-mile with an increase of 16.5 cents in the cost per train-mile. Inasmuch as the Mikado handles 330 tons more than the Consolidation it will take 3.55 Mikado trains to save one Consolidation train-mile. Inasmuch as each Mikado train costs 16½ cents more per train-mile than the Consolidation the product of 16½ x 3.55 equals 58.5 cents, or 7 cents less than the cost for a Consolidation train-mile. In other words, the real saving per train-mile is 7 cents instead of 65½ cents as might be roughly estimated.

When such a narrow margin of saving exists as shown in this case, it is worth while investigating the matter very carefully, considering another factor, namely, the interest on "additions and betterments" which were necessary to especially provide for the Mikados' repairs, housing, turning and their safe movement over the road. The feature of "additions and betterments" is one which should always be taken into account when considering change from small to large units; after they have once been made, as there is no way to get away from the interest charge thereon, it is of course, unnecessary to consider them if the two divisions to be compared have the necessary facilities; if, however, one division has the facilities and the question arises about transferring some of its power to another division which is not provided with the facilities, then in order to determine the propriety of switching a given amount of power to such division the determination should be made upon the new division's economy, including interest on "additions and betterments," versus the equipped division's economy, excluding this interest.

Consideration of the effect upon maintenance of way and structures due to the use of the larger locomotives has been purposely avoided, for the reason that it is still a moot question among engineers. The above study should indicate that a variety of angles exist from which to approach this subject, as well as

the importance of having the detail information such as is set forth currently prepared. Unless it is prepared currently, much of it is impractical to secure and thus precludes a definite knowledge of many vital items. Also, in making any such study the actual traffic conditions must be carefully considered.

## LOCOMOTIVE COAL CONSUMPTION\*

BY LAWRENCE W. WALLACE

Professor of Railway and Industrial Department, Purdue University

Last spring the department of Railroad and Industrial Management of Purdue University conducted certain road tests of locomotives to determine the relative efficiency of certain coals and methods of firing for the Monon. They were conducted through the co-operation of H. C. May, superintendent of motive power, and his staff, and the representatives of the Railway Mechanical Engineering Department of Purdue University. The tests extended over a period of 30 days, through which period observations were taken by students specializing in railway me-

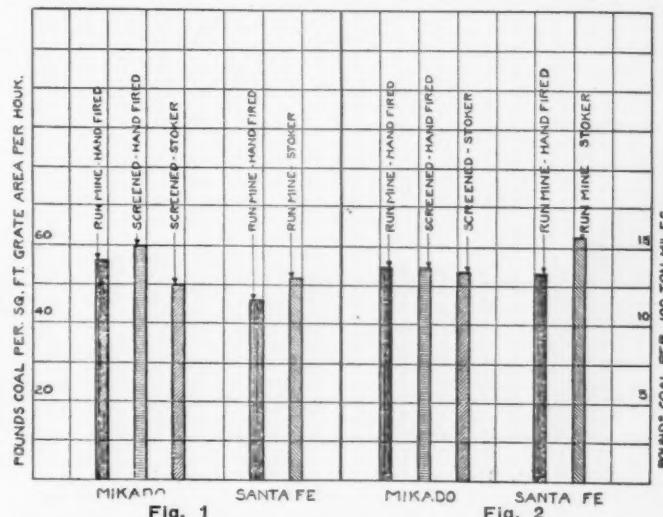


Fig. 1

Fig. 2

chanical engineering. They were designed to determine: The evaporative efficiency of the boiler of a Mikado and of a Santa Fe type locomotive, where screened and unscreened coal was used; and the evaporative efficiency of each of the two boilers when hand-fired and when stoker-fired, both screened and unscreened coal being used. Every precaution was taken to obtain accurate and reliable data. The tests were made between Lafayette, Ind., and Bloomington, a distance of 100 miles. The maximum grade was 2 per cent and the maximum curve 4 deg. For a considerable portion of the distance many curves and small grades prevailed. The locomotives were in fast freight service.

*Locomotives.*—Each of the Mikado and Santa Fe locomotives used were of the same respective class. The essential features of each are given in Table I. The locomotives were equipped

TABLE I.—PRINCIPAL DIMENSIONS OF THE LOCOMOTIVES TESTED

	Mikado	Santa Fe
Cylinders	28 in. by 30 in.	28 in. by 30 in.
Piston valves, diameter	14 in.	14 in.
Valve gear	Walschaert	Walschaert
Grate area	54.5 sq. ft.	70 sq. ft.
Heating surface, tubes	3,671 sq. ft.	4,485 sq. ft.
Heating surface, firebox	245.5 sq. ft.	282 sq. ft.
Heating surface, total	3,916.5 sq. ft.	4,767 sq. ft.
Tractive effort	53,900 lb.	66,700 lb.
Weight on drivers	218,000 lb.	278,500 lb.
Weight on leading truck	26,000 lb.	27,000 lb.
Weight on trailer	42,000 lb.	44,500 lb.
Total weight of engine	286,000 lb.	350,000 lb.
Weight of tender loaded	178,000 lb.	180,000 lb.

with Schmidt superheaters and were in good repair.

*Coal.*—The unscreened coal was the ordinary mine-run coal common to Southern Indiana. It contained from 50 to 60 per cent of slack. The screened coal was of the same grade as the

\* Abstract of a paper presented at the October meeting of the St. Louis Railway Club.

mine-run, the only difference being that it was put through a  $1\frac{1}{4}$ -in. mesh screen before being placed upon the tender. It contained a very small percentage of slack. It is known as No. 4. Each coal was hand and stoker-fired on each type of locomotive. A Standard stoker was used.

**Results.**—The average results obtained from the complete series are tabulated in Table II, the values given being the average of three round trips in each case.

A study of the table will disclose that fairly uniform conditions of speed and tonnage were maintained for the several tests. On a number of trips, however, abnormal waiting on sidings was experienced, and it was necessary to double a hill on several occasions. But as such irregularities were about as frequent in one of the tests as another, the relative results were approximately the same, hence the results are truly indicative of the merits of each coal and each method of firing. It should be said in behalf of the stoker that as soon as it was applied and given a short trial, the locomotive to which it was applied was

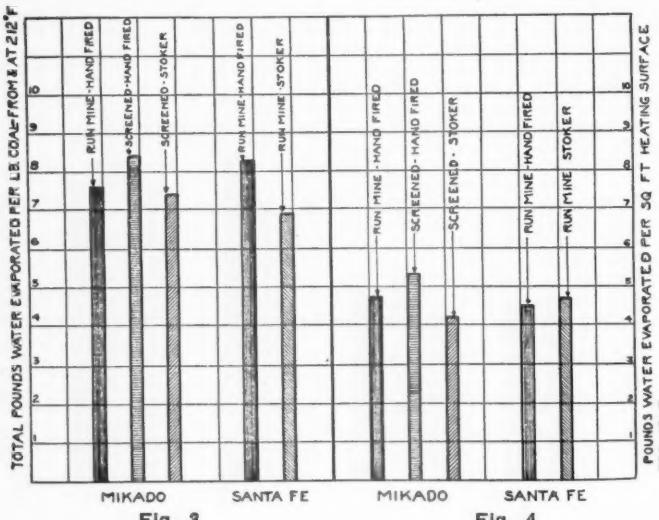


Fig. 3

Fig. 4

tested. This meant that the stoker was not fully adjusted in all respects. Again, the operator was required to fire a coal with which he had no previous experience. Bearing these things in mind, the performance of the stoker was very satisfactory.

Certain of the more important results have been plotted in order to make them more comprehensive. In Fig. 1 is plotted the pounds of coal fired per square foot of grate area per hour, for each of the several test conditions. This indicates the intensity of the rate of firing, which is a significant factor. It will be noted that with the Mikado a greater quantity of coal was

would indicate, therefore, that if it is necessary to crowd a boiler to near its limit, there is a greater possibility of doing so by the use of a stoker than otherwise, as more mine run coal can be continuously supplied to the grate per hour by means of a stoker than by hand. The point at which the heavy firing becomes a wasteful process depends upon several factors, namely: The draft, grate area, amount of heating surface and its condition.

It is interesting to note that the relative position of the curves

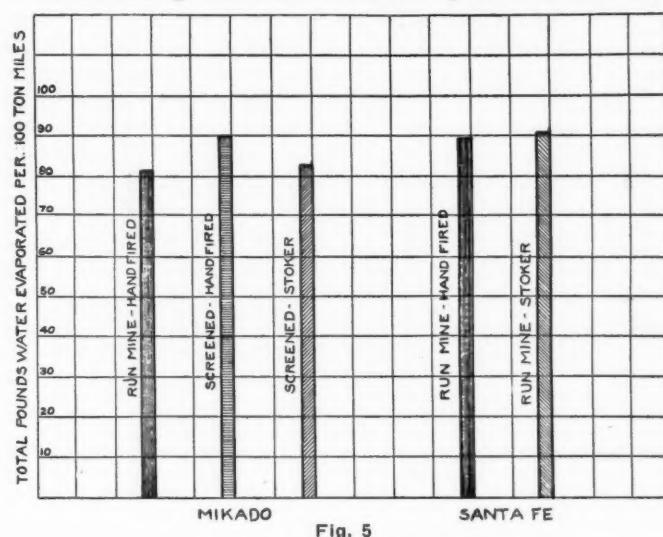


Fig. 5

for the Mikado locomotive, Fig. 3, are the same as they were in Fig. 1. That is, the best results were obtained when screened coal was hand fired. Screened coal, hand fired, gave an evaporation of 8.4 lb. of water from and at 212 deg. per lb. of coal. Mine run hand fired gave an evaporation of 7.6 lb., a difference of 10 per cent in favor of screened coal; and screened coal, stoker fired, gave an evaporation of 7.4 lb. of water per lb. of coal, a difference of 13 per cent in favor of screened coal, hand fired, as compared with stoker firing. The mine run, hand fired, gave an evaporation of 8.3 lb. of water per lb. of coal on the Santa Fe and only 6.9 when stoker fired, or a difference in favor of hand firing of 16.8 per cent.

The results plotted for the Mikado locomotive in Fig. 4 clearly indicates that a greater amount of water was evaporated per square foot of heating surface per hour when screened coal was hand fired than for any other condition of the tests. With screened coal, hand fired, an evaporation of 11 per cent greater was obtained than with mine run, hand fired, and 21 per cent more than with screened coal, stoker fired. There was only a difference of 4 per cent in the rate of evaporation when mine

TABLE II.—AVERAGE RESULTS OF COAL TESTS, HAND AND STOKER-FIRED

Locomo-	Kind of	How	Total	Speed	Steam		Consumed	Per sq. ft.	Per 100	Total coal, lb.		Per lb.	Per sq.	Per sq.	Per 100	
					B. P.	VII				X	XII					
I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV		
Mikado	Run of Mine	Hand	191,102	18.3	168.7	522	26,418	56	13.6	6.2	7.6	4.7	331.0	81.5		
Mikado	Screened	Hand	175,491	19.8	170.0	531	24,250	60	13.6	6.9	8.4	5.3	393.4	90.0		
Mikado	Screened	Stoker	180,123	19.2	168.5	533	24,200	50	13.4	6.2	7.4	4.2	303.0	82.8		
Santa Fe	Run of Mine	Hand	220,265	18.5	187.5	489	29,233	46.4	13.6	6.8	8.3	4.5	304.0	89.3		
Santa Fe	Run of Mine	Stoker	234,382	18.7	176.2	520	35,933	52.0	15.6	5.75	6.9	4.1	313.8	90.4		

burned per square foot of grate per hour when screened coal was hand fired than when mine run was so fired. Also that the smallest amount was burned when screened coal was stoker fired. With the Santa Fe locomotive a greater quantity of coal was burned when mine run coal was stoker fired.

On the basis of coal consumption per 100 ton-miles, as shown in Fig. 2, it is apparent that the amount of coal burned per 100 ton-miles was approximately the same for each of the three conditions indicated for the Mikado locomotive. But for the Santa Fe a greater quantity was consumed per 100 ton-miles when mine run coal was stoker fired than when hand fired. This

run coal was stoker fired and when hand fired.

Another measure of the relative merits of the coals used and firing methods employed is shown in Fig. 5, the unit of measurement being the total pounds of water evaporated per 100 ton-miles. Again, with the Mikado locomotive, screened coal, hand fired, gave the best results, there being an evaporation of 9.4 per cent more with screened coal, hand fired, than mine run, hand fired. Approximately the same results were obtained with mine run, hand fired, and screened, stoker fired. With the Santa Fe better results were obtained with the mine run, stoker fired, than hand fired. The amount in favor of stoker was very small.

# CAR DEPARTMENT

## CAR DERAILMENTS, CAUSES AND A REMEDY

BY H. M. PERRY

The derailment of cars, especially those of recent steel construction, is a matter to be seriously considered by both the operating and mechanical departments of the railways. The demand for greater carrying capacity and the increase in weight and speed of trains has forced the builders to substitute steel in place of wood in all classes of car equipment, either in the form of steel underframes or of all-steel construction. This produces a car frame that is absolutely rigid, so much so that a jack placed under one corner of a car will raise the whole end as square as though the jack were placed under the middle of the end. When such a car enters a curve where the outer rail is elevated 4 in. or more, and the approach is comparatively short, the weight on the forward end of the car is carried almost entirely by the outer forward side bearing, unless the clearance between the side bearings is sufficient to overcome the difference in the elevation of the rails. This is seldom the case, except perhaps on new equipment before the bolsters deflect or the center plates wear down and reduce the clearance between the bear-

side bearings are in contact, the outer rail being elevated 5 in. Now, when the load is suddenly changed from the position shown in Fig. 2 to that shown in Fig. 3, it relieves the load on the outer wheels and sometimes raises them off the rail, the car falling over on the inside of the curve. This is particularly the case with some refrigerator cars, when the load is hung from the roof, although many of the all-steel box cars, as well as some of the hopper cars, have met the same fate.

An illustration of the trouble caused by a high center of gravity with the side bearings placed at 60-in. centers and with over  $\frac{3}{8}$ -in. clearance between them, together with an excessive elevation of the outer rail on a curve, may be had in an actual case of a refrigerator car loaded with meat hung from the roof, and running at a speed of 10 m. p. h. This car rolled over on the inside of the curve. The car was unloaded and set back on the track only to immediately tip over again. To hold it upright it was necessary to use guy lines until it was moved to a level track. Of course, this was an exceptional case and under abnormal conditions, but serves to show the tendency of cars to tip over when these conditions obtain.

Similar cases occurred on a western road which had 1,000 refrigerator cars, a very large number of which were derailed

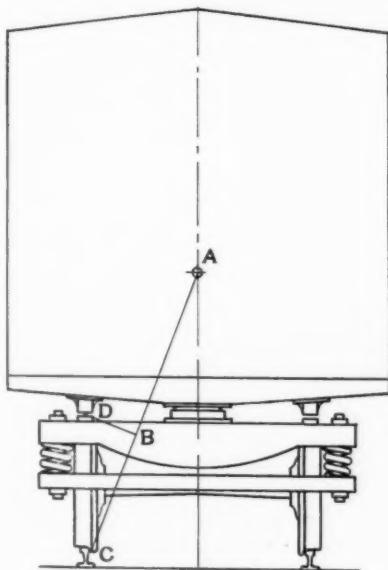


Fig. 1

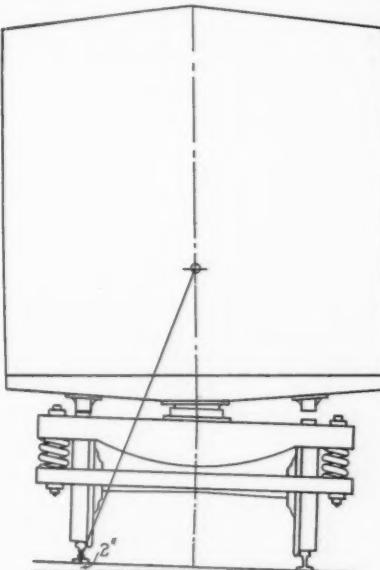


Fig. 2

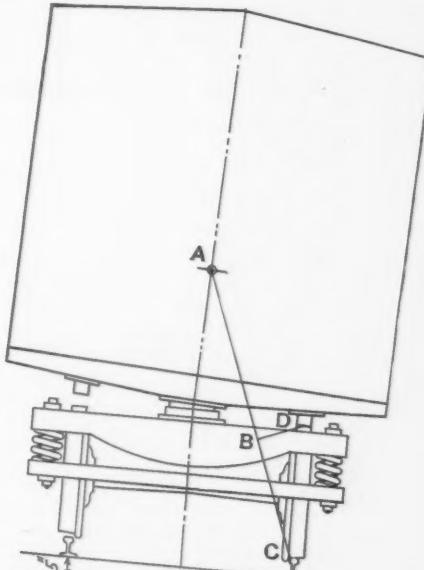


Fig. 3

ings. When rigid cast iron side bearings are used on these cars the friction between them is often greater than the reaction between the wheel flange and the rail, and as a result derailment occurs. The same condition will be found when such cars are leaving a curve; in this case the derailment almost always is caused by the leading outer wheel on the rear truck mounting the rail.

Another cause of many derailments is the position of the side bearings on the bolsters and excessive clearance between the bearings, especially where the car has a high center of gravity. Fig. 1 shows a car standing on a level track, the side bearings being placed at 60-in. centers with  $\frac{3}{8}$ -in. clearance, and the center of gravity of the car being 6 ft. above the rail. Fig. 2 shows this car entering a curve, where the outer rail is elevated only 2 in., and with the outer side bearings in contact, the load being distributed between that point and the center plate. Fig. 3 shows the car on the curve, but tipped down so that the inner

under every possible condition and on almost every road over which they were operated. These cars had a high center of gravity, rigid side bearings, which were placed on 60-in. centers, and  $\frac{3}{8}$ -in. clearance between the bearings. It seemed to make no difference whether these cars were loaded with meat hung from the roof or with merchandise; they simply left the track at every opportunity and apparently without any cause whatever. Later this same company purchased another lot of 1,000 cars, built to the same specifications, but provided with roller side bearings placed on 54-in. centers having only about  $\frac{1}{4}$ -in. clearance. The road never had a case of derailment with this lot of cars, which looks like conclusive evidence that the side bearings prevented the derailment of these cars.

Another interesting case was that of a heavy express car built new at a railroad shop. This car had a rigid steel underframe and was mounted on the road's standard steel trucks. It was 42 ft. long over end sills, with a rather high center of grav-

ity, rigid side bearings were placed on 60-in. centers with a clearance of  $\frac{3}{8}$  in. In order to limber up the car, it was sent out empty, and at the first sharp curve the outside leading wheel left the rail, the friction on the outer side bearing being greater than the reaction of the wheel flange against the rail, the same condition as shown in Fig. 2. The car was replaced on the track and carefully run over the rest of the line. Believing that the first derailment was caused by the car being light, it was then loaded to about one-half its capacity and started back home. On leaving another sharp curve the outer leading wheel on the rear truck left the rail evidently for the same reason as in the first derailment. The car was then sent to the shops and carefully inspected, the trucks trammed and everything found to be in perfect condition, but it was decided to increase the clearance between the side bearings to overcome the difference in the elevation of the rails, and they were set with about  $\frac{1}{2}$  in. clearance all around, making a bad matter worse. The car was then loaded to its full capacity, and sent out. It took the sharp curves without any trouble, but in running down a grade at a good rate of speed, over a heavy fill, the car began to rock from side to side until the wheels on one side of the car were lifted off the rail and the car was badly wrecked. Roller side bearings with not over  $\frac{1}{8}$ -in. clearance were then applied, and the car has been in continuous service over the same line for over a year and has never had another derailment.

It is undoubtedly a fact that under abnormal conditions, such as an excessive elevation of the outer rail on a curve, with a comparatively short approach, and a rigid car with only a slight clearance between the side bearings, that almost the entire load on one end of the car, sometimes exceeding 40,000 lb., is transferred to the outer leading side bearing, and if these bearings are rough cast iron, as are usually applied, the friction between them would be at least 50 per cent or something over 20,000 lb. As these conditions can and often do exist, is it any wonder that we occasionally have a so-called mysterious derailment? In a series of tests made with a pair of unlubricated malleable iron side bearings loaded with 4,000 lb. and the power applied to a lever 31 in. long, approximately the distance from the king bolt to the flange of the wheel on the rail, it required a force of 1,200 lb. to produce motion, while with a roller bearing having a 3-in. roller, under the same condition, only 70 lb. was required to move the load, a reduction of 94 per cent in power required. At the present time there are over one-quarter of a million cars equipped with some of the different designs of anti-friction side bearings, many of the large roads having from 10,000 to 20,000 cars so equipped, and as about 75 per cent of all the cars recently built are similarly equipped, it is reasonable to assume that the results obtained have not been unsatisfactory.

## ELECTRIC LIGHTING OF PASSENGER CARS\*

BY E. S. M. MACNAB

Engineer of Electric Car Lighting, Canadian Pacific, Montreal

There is a strong demand for electric light on passenger cars from both standpoints of safety and comfort. The possibility of fire in case of wreck is practically nil when electric light is used. Taking the question of comfort, the chief advantage is the application of berth lights in sleeping cars, together with the use of fans in dining and parlor cars, in addition to which may be added a cooler light devoid of all odor which comes from gas lighting, and the ability to place lights in any position in a car where they may be most convenient.

The number of electric-lighted cars in service in Canada and on certain roads in United States in 1911 and 1914 is shown in the table. It is apparent that there is a strong demand for electric lighting in passenger cars, and also that the railways are meeting it in a liberal spirit.

The electric lighting of passenger cars may be divided into three main classes—straight, storage, head end and axle systems.

The straight storage, while it is the simplest system, requires cars being held in terminal yards from six to ten hours for recharging batteries. This system is, therefore, out of the question for transcontinental services, as any road which has not a surplus of rolling stock cannot afford to hold its trains in the terminal yards for sufficient time to charge the batteries. Another disadvantage is the heavy capital cost of installing the necessary battery-charging facilities at all terminals.

The chief disadvantage of the head end system is the want of flexibility, and this is felt where trains have to be remodeled at junctions and cars switched off on branch lines. This leads to the necessity of equipping a large proportion of the cars on every train with batteries, increasing the capital and maintenance costs. Another disadvantage is the high steam consumption of the turbine.

The axle system, which is the most extensively used, comprises a generator driven by a belt from the axle and a set of

TABLE SHOWING INCREASE IN ELECTRICALLY LIGHTED CARS, 1911 TO 1914.

Railway company	Number of cars equipped 1911	Number of cars equipped 1914	Increase in cars equipped
Canadian Pacific .....	68	359	291
Grand Trunk .....	34	164	130
Grand Trunk Pacific .....	..	72	72
Canadian Northern .....	14	226	212
Total in Canada.....	116	821	705
Pennsylvania Lines East...	902	1,924	1,022
Pennsylvania Lines West...	516	714	198
N. Y. C. & H. R. ....	202	1,007	855
N. Y., H. N. & H. ....	350	410	50
Lehigh Valley .....	81	384	303
Great Northern .....	480	650	190

storage batteries which supply current to the lamps when the train is at rest. As this equipment is applied to each car, it follows that it is an individual unit and can be transferred to any line in any class of service without any adjustment of the apparatus being necessary.

**Batteries.**—If a number of electricians who operate electric-lighting equipments were asked to name the details which cause the most trouble, I am sure 90 per cent would reply, "the batteries." To maintain a storage battery in good working condition it should, as far as possible, receive about 20 per cent more charge than discharge, but continuous overcharging will cause the plates to buckle, and also create an excessive deposit of sediment, either of which will result in short-circuiting the plates, causing the cells to lose their charge and become "dead." Overcharge will also increase the evaporation of the electrolyte, which, if not replaced by adding water, will result in damage. The ill-effects of undercharge are also to be noted, as, owing to the action of the acid on the plates, in a discharged condition a sulphate of lead is formed which will have the effect of reducing the capacity of the cell which may be removed by a continuous slow charge. As the charge in a set of batteries gradually leaks out when left standing for a long period, electric-lighted cars should not be taken out of service and stored in yards where charging facilities are not available. It is the Canadian Pacific's practice to charge the batteries on all cars not in service at least once a month.

Another source of trouble is the current leaking to earth through the lead-lined tanks, which will take place if the bottoms of the cells are allowed to remain wet. At the point where the leakage takes place in the lining an electrolytic action follows, which eventually produces a hole in the lining, allowing the acid to leak away; this happening in one cell will probably start the rest in the battery box. To prevent this, care should be taken to keep the outside of the cells and floor of the battery boxes as dry as possible and well insulated from the iron work of the cars. My reason in calling attention to these troubles is to bring out the fact that, as the battery maintenance is the heaviest item in the lighting on most railways, considerable sav-

\* Abstract of a paper read before the Canadian Railway Club on October 12, 1915.

ing may be effected by paying attention to the various points which tend towards good battery maintenance.

#### ORGANIZATION

The question of organization is the chief factor to be determined if efficient results are to be obtained. To illustrate the capital expenditure and maintenance costs, take a road having 400 electric-lighted cars. As each installation will cost, say, \$1,500, we have a total expenditure of \$600,000, of which \$800 per car, or a total of \$320,000, is liable to be permanently destroyed through want of attention. Assuming a total of 400 cars at a maintenance cost of \$12.00 per car per month, we have a maintenance cost of \$4,800 per month, or \$57,600 per annum. If by better handling we save one lamp per car per month, we effect a saving of \$180 per month, or \$2,160 per annum. Again, a conservative estimate will place the life of a battery set at five years. Assuming we have twenty-four batteries per equipment and that we increase their life by one year; taking the cost of the batteries as \$630, we have:

Depreciation at 5 years.....	\$126 per annum
Depreciation at 6 years.....	105 per annum
Saving per car.....	\$21 per annum

Multiply by 400 cars and we have \$8,400 per annum saved.

Again, take the question of belt life. A saving of one belt per car per annum will approximate \$5 per car per annum, of \$2,000 per annum on 400 cars.

Summarizing, we have:

Saving of one lamp per car per month.....	\$2,160 per annum
Extending life of batteries by one year.....	8,400
Saving one belt per car per annum.....	2,000
\$12,560 per annum	

These figures show what may be saved or lost through proper handling or neglect of the equipments, setting aside the discomfort caused to passengers due to light failures.

There is a considerable difference in the methods of organizing this work on the railroads in the United States. In some cases the forces are controlled directly by a chief electrician, who reports to the master car builder. On some roads the chief electrician acts in an advisory capacity to the master car builder, the forces being controlled by the car foreman; on others the electrical engineer, through his assistants, directly controls the terminal electricians. On one road in the United States the electricians are carried on the car foreman's pay roll, and are responsible to him as far as matters of discipline are concerned, but are responsible to the chief electrician for all technical work. As a general rule, the closer the chief electrician or electrical engineer is to the inspection forces, the more efficient the organization.

The chief electrical engineer should supervise the preparation of the specifications and wiring diagrams for all new rolling stock and see that they are lived up to by the car builders. This is important, as all equipments, as far as possible, should be installed to certain standards; the various conduit runs should be inspected to see that new wires may be drawn in at any time without tearing down the interior finish of the car. The quality of the conduit and wires should also be closely watched, as these items will affect the cost of maintenance in later years.

The generator suspension should be closely checked with the object of providing for sufficient belt clearance; it will well repay any railway to give this point due consideration, as it is no idle statement that fully half the light failures and lost belts are due to insufficient clearance.

The type and location of fixtures should also receive attention. As far as possible, standard types should be used, involving the minimum number of classes of glassware; as a rule, clear, unshaded lamps should not be used, as they are liable to cause eye strain. It is also advisable to standardize one size of lamp, which, on a large system, must be carried in the stores at all terminals.

The introduction of 50-watt gas-filled lamps which have re-

cently been placed on the market should considerably reduce the number of fixtures and also simplify their construction.

#### MAINTENANCE OF EQUIPMENT

To maintain the equipments in a proper state of efficiency periodical inspection and overhaul are necessary, and any neglect of either will result in a heavy expenditure for renewals.

Each equipment should receive a thorough overhaul once a year, when the generator should be removed from the car, taken apart, cleaned and worn parts renewed, and on being rebuilt should be tested on a special test frame. The batteries should also be taken to the battery house, where each cell should be opened up, the cell box washed out under a spray, all bent plates straightened, and damaged separators renewed. The battery should then be reconnected in the shop and properly charged, when a discharge test should be taken and its capacity noted. After recharging, the specific gravity of the electrolyte should be adjusted and the cell and battery boxes painted. The set is then fit to be replaced on the car. If the car is fitted with lamp and generator regulators they should be reset, the carbons being specially examined. Considerable difference of opinion exists as to whether this overhaul should be carried out at the terminal yards or at the shops of the company. In favor of the former system it is claimed that, by changing the equipments at the terminals, the overhaul is not dependent on the shopping of the cars, which in some cases is not on the twelve months basis. Also that more interest is taken in the work by the yard staffs than by the shop men. The latter method has the advantage of concentrating the work and insuring a standard treatment of each equipment and therefore lends itself to better organization.

*Inspection.*—A yard force, under the supervision of a chief electrician or foreman, should be located at each terminal where trains originate, and each car arriving should be inspected to see if the equipment is in good working order before leaving on its next trip, and then all necessary running repairs made. At each inspection the height of the acid in the batteries should be noted, and water added, if necessary. Neglect of this will cause sulphating of the plates, decreasing the capacity and life of the batteries.

#### YARD FACILITIES

The modern battery room is equipped with a washing table on which the elements can be inspected and also a compressed air and water spray over which the cell box is cleaned. Benches should also be provided to hold at least six sets of batteries while they are being charged up prior to being applied to the cars. Acid tanks for mixing new electrolyte and for holding electrolyte removed from cells while they are being overhauled should be provided, together with a press for straightening plates, also steam-jacketed tanks for boiling the acid out of connections, etc. A still should also be installed if Edison batteries are used.

The generator repair room should be fitted with a bench on which a generator may be conveniently dismantled and rebuilt. A work-bench with a vise is also necessary, together with lockers and cupboards.

Battery charging facilities should be provided in the battery room and throughout the yard, in order that the batteries on any car may be charged without switching the car to any special point.

#### RECORDS

A set of records should be kept in the electrical engineer's office, showing the details of the equipments on each car, together with a separate battery record. A statement of failures should be prepared each month, showing the number of cases of trouble, the type of equipment and batteries with cause of trouble. From this an efficiency statement is made up, showing the number of failures per thousand car miles, also the number

of miles per failure. It is thus possible to watch the operation of the equipments and make comparisons of them from month to month.

#### ACCOUNTS

The determination of the cost of operating the equipments is one of the most important items to be followed up, as without a proper accounting system it is impossible to trace any of the numerous leaks which may occur in the maintenance. Undoubtedly the most satisfactory method of keeping accounts is one which gives the cost of labor and material of each car per month, from which the cost of the various systems in operation can be ascertained. But such a system is not always possible.

#### CONSERVATION OF LIGHT

All who are connected in any way with the operation of electric lighted equipment should assist in saving as much light as possible while the cars are in the coach yards, terminals, etc. By all means give the passengers all the light they require, but save the waste. Probably gas lighting is more or less responsible for much of the waste which now prevails, as it is possible to use the gas in the tanks before a train arrives from the yard to receive its passengers, and replenish the tanks in a few minutes, whereas to recharge the batteries of an electric lighted car may take eight or ten hours.

### NEW M.C.B. EXPERIMENTAL COUPLERS

The Master Car Builders' Association has recently issued Circular No. 7 from the Committee on Couplers, showing the

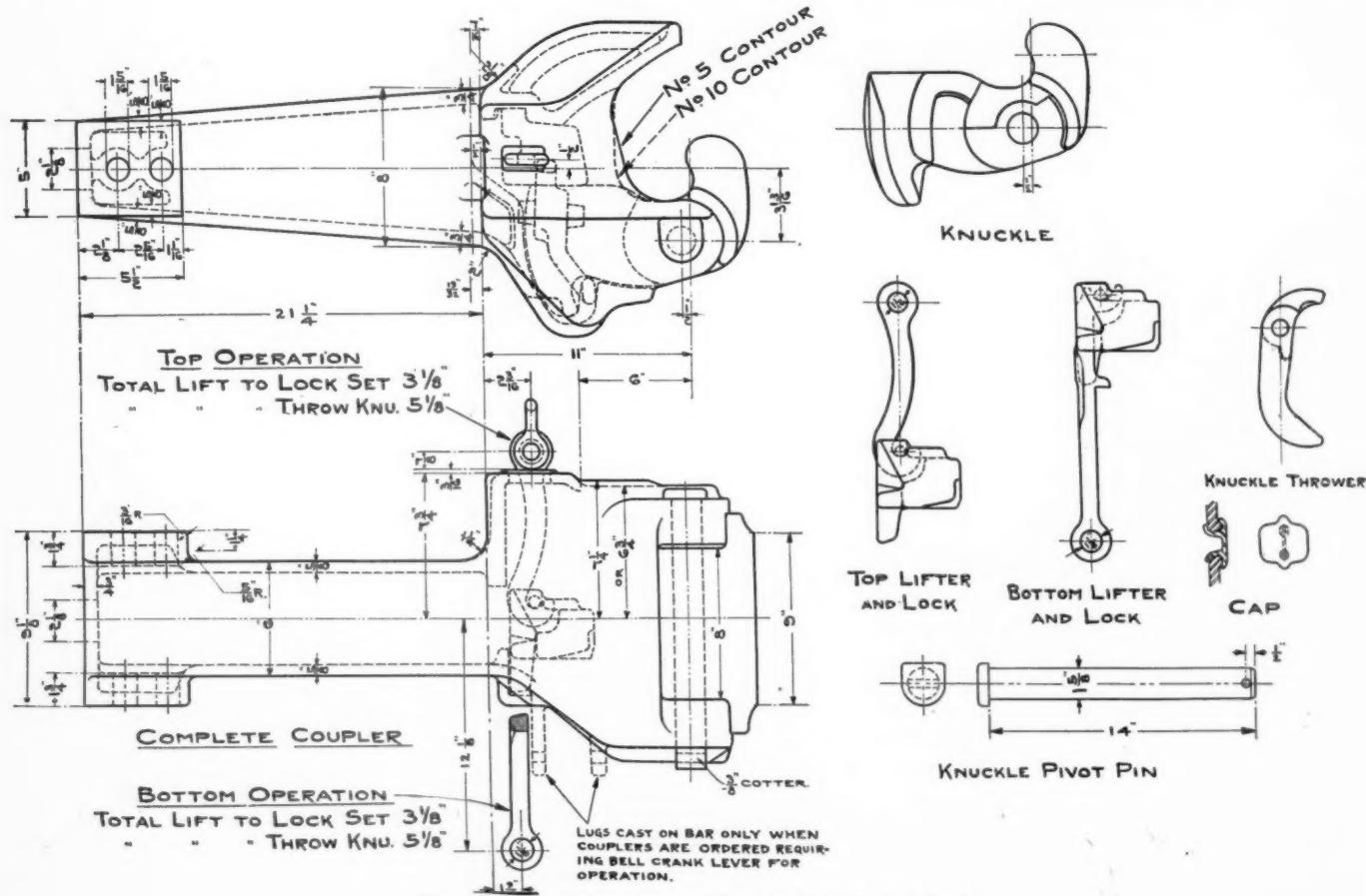


Fig. 1—Type C Experimental Standard M. C. B. Coupler

general outline of the types *C* and *D* experimental couplers. The principal changes involved in the type *C* coupler (Fig. 1), which supersedes the type *A*, are as follows:

Location of the lockset changed from the guard-arm wall to the rear wall.

Lengthening the vertical guide of the lock.

Addition of a longitudinal rib on the knuckle side of the head, supporting the front face of the head.

Change in the lock lifter for top operation, making it detachable from the lock and entered from the top of the head.

Changes to the bar, knuckle, lock and kicker to accommodate the above and other slight modifications.

The principal changes involved in the type *D* coupler (Fig. 2), which supersedes type *B*, are as follows:

Addition of a pulling rib to the bottom of the knuckle tail. Redesign and strengthening of the guard-arm.

Fulcrum boss and front of the lock changed and a corresponding change made in the lock chamber in the bar.

Removal of the unsupported portion of the striking horn on the knuckle side.

Changes to the bar, knuckle, lock and kicker to accommodate the above and other slight modifications.

Fig. 3 shows the comparison of contour lines. The contour lines Nos. 5 and 10 were slightly modified in order to use the same knuckle in either contour line. This was accomplished without decreasing the horizontal angling of the No. 5 contour, and gave an increase of half a degree in angling of the No. 10 contour.

The dimensions of types *A* and *B* couplers may be found in the *Daily Railway Age Gazette* of June 16, 1915, on page 1360.

Regarding the use of these couplers in actual service, the committee said, in part, as follows:

"In order that the members of the association will be in a position to select for adoption as a standard either the type *C* or type *D* coupler and either the No. 5 or No. 10 contour lines,

it is essential that each railroad place in service immediately a sufficient number of each of the two types of couplers *C* and *D*, with both the Nos. 5 and 10 contour lines, from which to draw

their conclusions. These service trials will be augmented by a series of static and dynamic tests, conducted by the committee, similar to those made on the types *A* and *B* couplers. These trials should preferably be made on locomotives, in order to obtain the most severe service, and need not be delayed for an order of new locomotives, as the couplers can be ordered and procured with any type shank desired and used to replace couplers on present equipment. Freight cars may also be fitted with these couplers to a limited extent. Both contours Nos. 5 and 10 should be tried out without fail on all installations.

of laying off the couplers and recording the measurements taken in the tests.

### EFFECT OF MOISTURE IN THE AIR BRAKE SYSTEM

Water in the air brake system is likely to cause trouble in a number of directions, principal among which are cut valve seats, due to the lubricant having been washed away; inade-

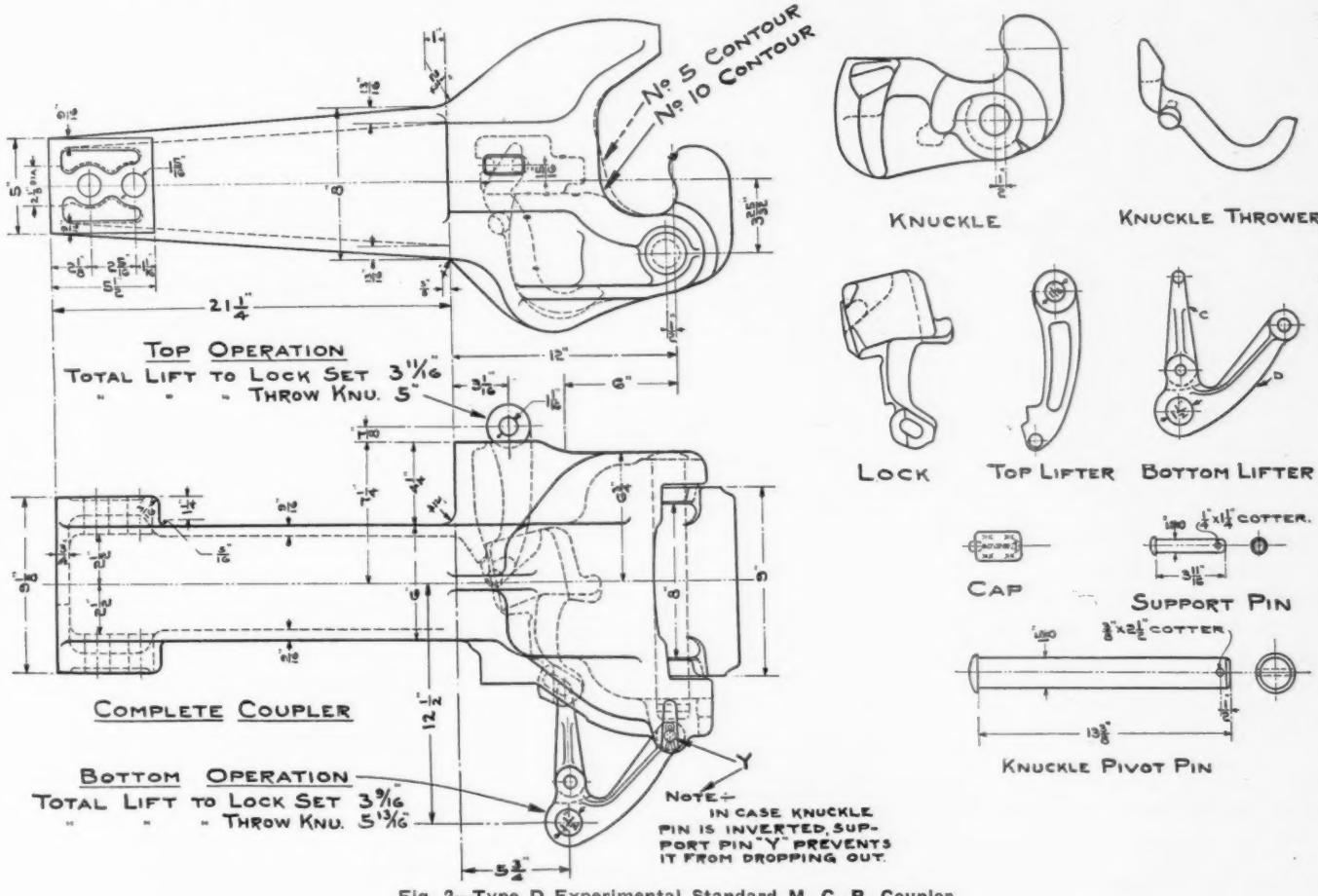


Fig. 2—Type D Experimental Standard M. C. B. Coupler

"The type *C* coupler is manufactured at present only by the American Steel Foundries, and the type *D* is manufactured at present only by The National Malleable Castings Company. The

quate air supply at times due to the volume of containers having been reduced by the water; and, worst of all, stopped up pipes and defective valves resulting from the water collecting in the pockets and freezing. It is therefore desirable to insure that a minimum amount of water enters the system.

Water vapor is present in the air at all times in varying quantities according to the locality, the weather conditions, etc. The water vapor itself can do no harm as long as it remains a vapor for it is then a gas, similar to air in its action so far as air brake processes are concerned..

The maximum amount of moisture that pure air can contain depends only on its temperature and pressure, and has an unvarying value for each condition. The higher the temperature of the air the greater is the amount of moisture that it can contain. The higher the pressure of the air the smaller is the amount of moisture that it can contain. The rise in temperature due to the compression of the air, in all cases found in practice, far more than offsets the opposite effect of the rise of pressure on the moisture carrying capacity of the air. Obviously there are two ways of accomplishing the desired results, namely: Maintain throughout the brake system the temperature at which the air enters the system; and eliminate the moisture before the air is passed to the brake system.

The elimination of all moisture which can cause trouble

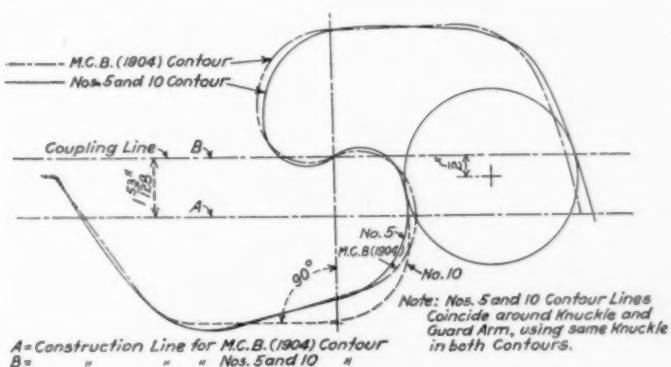


Fig. 3—Comparison of Contours

couplers may be ordered direct from these manufacturers or through any other of the coupler manufacturers who are members of the joint committee to design the standard M. C. B. coupler. The price will be the same."

The circular also contained illustrations showing the method

can be accomplished if the temperature of the air is reduced to that of the atmosphere before it enters the brake system and therefore the second of the courses mentioned above is the practicable one. Suppose air at atmospheric pressure to contain only 25 per cent of the maximum amount of water it can carry, it is necessary to raise it to only four atmospheres, or 45 lb. gage pressure, to bring it up to 100 per cent saturation. As the compression continues above this point all excess water vapor will be precipitated unless one thing happens, viz., the temperature is raised sufficiently to prevent the saturation point being reached. During the actual process of compression this is precisely what takes place. The heat generated by compression more than offsets the tendency of the increasing pressure to precipitate any of the water and the result is that no moisture is ever deposited in the compressor while in action.

When the air reaches the reservoir, however, it gives up its heat by radiation but with a relatively small loss of pressure, so that as the temperature falls the saturation point is soon reached and precipitation takes place. This process of precipitation continues until the air in the reservoir is either of the same temperature as its surroundings or until some of it is drawn off into the system. It may be that air leaves the main reservoir always at or about 100 per cent saturation and therefore at the precipitating point. But if the temperature drops no further the remaining water vapor will continue in the air as such throughout its course through the system.

Expansion, it is true, will take place throughout the system during the functioning of the parts and will result in dropping the pressure, thus tending to raise the saturation point and simultaneously in reducing the temperature, thus tending to lower the saturation point. However, with the pressure used in ordinary air brake work there is no place in the brake system where the expansion will be sufficiently great or rapid, that the second of these antagonistic features can predominate and result in precipitation, provided the system is properly installed. That the opposite effect can be produced is quite true. For instance, a very considerable drop in pressure at a fast rate could be brought about by a restriction at some point in the conduit through which the air has to pass. What might happen in such a case is that in manipulating the brakes the air would expand very rapidly through this restriction and moisture would be deposited on the walls of the conduit. This would become frost and further restrict the opening until finally the pipe would be closed.

The general practice of the day in the compression and transmission of air does not seem to make adequate provision for disposing of the water deposited by the air while cooling. In connection with the compressor, and usually quite near it, a receiver or reservoir of considerable capacity is provided, the most important function of which is, or is assumed to be, that of collecting the water that may be precipitated by the compressed air. In too many cases this receiver fails of its mission or only partially collects the water from the air, because if the compressor is working constantly and rapidly, as it usually does, the air goes through the receiver and out of it and into the system before it has time to cool. The air after compression will not drop all of its water until it is thoroughly cooled and the cooler it gets the greater will be the quantity of water liberated. Cases are quite common where a second receiver placed at the farther end of a pipe-line has effectually cured the freezing up by removing the congealable liquid. To get rid of all trouble from water vapor in the air, and the precipitation and possible freezing of it, care should be taken that when the air passes a point where it is still at full pressure and has reached its lowest temperature, such means of drainage shall be provided that none of the liberated water shall be carried into and along the pipes beyond that point. To guard against the air reaching the brake system at a temperature above that of the atmosphere and against great and rapid expansion until after it has passed the operating mechanism are the only things that can be done with compressed air to

prevent precipitation and its consequent ill effects. The above considerations demonstrate the prime importance of having an amount of radiating surface in the main reservoir and connecting pipe of an air brake installation sufficient to cool the compressed air to atmospheric temperatures before it is passed into the brake system. Also that no restrictions exist in the piping between the container and the device through which it is delivered to the air brake system or operating apparatus unless such restrictions be placed where the temperature is always above freezing.

To facilitate the cooling of the air the piping and reservoirs should have as free an exposure to the atmosphere as possible in order to obtain a good circulation as well as to avoid the heat of the locomotive firebox. Ample capacity should be provided for in the storage reservoirs to insure air free from moisture being delivered to the brake system even though the reservoirs are called upon to furnish quantities of air in rapid succession to the brake system, as is the case in taking a heavy train down a long grade. The reservoir should be provided with drain cocks of large capacity and should be easy of access. The installations should be so made that the radiating pipe will drain into the first reservoirs and that the drain cock is at the lowest point of the reservoir. Special care should be exercised to eliminate pockets and reheating. With all of this precaution, if the reservoirs are not drained regularly, the water will be carried into the brake system.

To facilitate the installation and to obtain the greatest amount of cooling area, it has been found that to divide the reservoir capacity into two units and have each reservoir of relatively small diameter in comparison with its length (proper volume considered) gives the best results. In addition to this it is necessary that a sufficient length of radiating pipe be provided for radiating purposes between the compressor and the first reservoir and between the two reservoirs. This length of radiating pipe will be determined by climatic conditions and will therefore vary somewhat, but should never be less than 25 ft. in length in either case. The undesirable results enumerated are cumulative and influence the entire brake system and its operation, and although many more reasons could be given and examples cited, sufficient has been said to demonstrate the importance of a proper consideration of this problem.

## MAKING GOOD CAR INSPECTORS\*

BY C. S. TAYLOR

General Foreman, Atlantic Coast Line, Wilmington, N. C.

Good car inspectors, like good roundhouse foremen, are "born and not made." As the demand far exceeds the supply, it has brought about quite a problem as to how to overcome the deficiency. It has been solved on our road to a great extent.

We hire a boy from 18 to 20 years of age, one from the country preferred, and take special note of his physical qualifications. We first place him in the car repair yard as a laborer, his duties being to handle stock from the material piles and storehouse to the cars; we also let him assist car repairers in repairing cars, giving him a knowledge of car construction and the names and uses of different parts of the car. After he has proved himself proficient and a good worker we place him on the wrecking force at the first opportunity. All laborers on the wreck force are white. This gives him experience that he would not get in the shop, and he becomes familiar with failures of different parts of the car; if a wreck is caused by poor inspection it impresses on him the importance of close inspection. After working a while on the wreck force, we place him as an inspector's helper and furnish him with an M. C. B. rule book and the loading rules. He is now commencing his real education as car inspector. The duties of the car inspector's helper are to assist the inspector as much as possible, working trains in and out of the yard. More responsibility is placed on

\* Entered in the Car Inspectors' Competition, which closed October 1, 1915. For prize article see November issue, page 575.





having one of its ends connected to the car body. With such an arrangement there is no horizontal reaction at the center plate due to the pull of the brake rod. The bolster is supported horizontally in vertical guides at each end. These provide the reactions for the horizontal load at the center plate, and we have a simple beam supported at the ends with the load in the middle. The fiber stress due to vertical bending plus the stress due to horizontal bending must not exceed the permissible maximum working stress of the material.

When passing over sharp curves, switches and frogs one of the very noticeable effects is an abrupt sidewise lurching of the car. The office of the swing hangers is to allow the bolster to move laterally in order to avoid shock. This movement is usually limited to less than two inches, and is checked by the use of helical springs of proper capacity, but if the hangers are sufficiently short no springs are required.

The correct length of hangers for use with or without springs

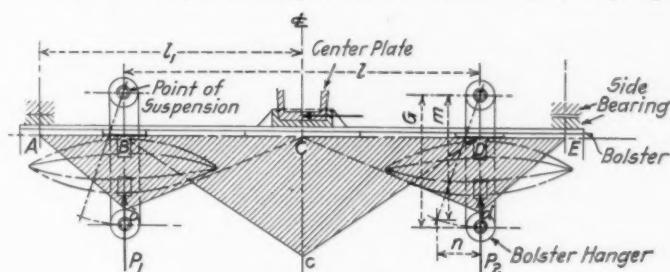


Fig. 4

may be calculated when the limit of the speed of the train on curves is known. In Fig. 4 let

$F$  = centrifugal force per lb. of train on the curve.  
 $y$  = permissible speed of train in miles per hour.  
 $W = P_1 + P_2$  = weight on the four hangers.  
 $G$  = the required length of hangers in inches.  
 $T$  = the required lateral resistance in pounds of the spring when solid.  
 $n$  = the lateral movement of bolster in inches.  
 $m$  = vertical height center to center of the hanger  
 in inches =  $\sqrt{G^2 - n^2}$ .

Taking moments about the point of suspension

$$Wn = (WF - T) m \text{ or } m = \frac{Wn}{WF - T} \quad (47)$$

For a body weighing one pound, the centrifugal force will be as follows:

$$\begin{aligned} F &= .0001165 y^2 \text{ on 10-deg. curves.} \\ F &= .000175 y^2 \text{ on 15-deg. curves.} \\ F &= .000233 y^2 \text{ on 20-deg. curves.} \end{aligned}$$

Substituting in (47), the length of hanger for any value of  $F$  and any weight of car is

$$G = n \sqrt{\left(\frac{W}{WF - T}\right)^2 + 1} \quad (48)$$

and the resistance required of the springs is

$$T = W \left( F - \frac{n}{\sqrt{G^2 - n^2}} \right) \quad (49)$$

*Example.*—Assume the following conditions:

$y = 35$  m.p.h. = the limiting speed of the train on a 15-deg. curve.  
 $W = 52,000$  lb. = weight on all hangers of the bolster.  
 $n = 2$  in. = lateral movement of bolster each side of center line.  
 $T = 0$ .

For a 15-deg. curve at 35 m.p.h., the value of centrifugal force per lb. of train weight is

$$F = .000175 \times 35^2 = 0.214$$

Substituting in (48), the length of hanger is found to be

$$G = 2 \sqrt{\left(\frac{52,000}{52,000 \times 0.214 - 0}\right)^2 + 1} = 9.55 \text{ in.}$$

The correct length of hanger for use without springs is 9.55 in. Suppose, however, that because of limitations in design two hangers 18 in. are to be used. By formula (49)

$$T = 52,000 \times \left( 0.214 - \frac{2}{\sqrt{18^2 - 2^2}} \right) = 3,360 \text{ lb.}$$

A spring will be required having a maximum resistance of 3,360

lb. to check the lateral swing of the bolster in two inches without shock.

Oblique suspension of bolster hangers is a common practice one of the good features of which is the tendency to shift the center of gravity of car body towards the inside of curves, thus adding to the stability of the car on the rails. However, the advantage of inclined hangers is somewhat doubtful, as the arrangement necessitates the use of a spring plank, which is loaded as a strut, the horizontal components of the weight on the hangers acting at the ends. In some cases, on account of clearances, the spring plank must be made heavy enough to bear eccentric loading, which adds to the weight of the heavy construction and results in a few hundred pounds more dead weight, from which no adequate advantage is obtained. Owing to the comparatively low center of gravity of steel cars, the stability on the rails is well on the side of safety and vertical suspension with lateral motion springs is more desirable.

A type of hanger from which more is to be gained than from inclined hangers is a vertical hanger with three bearing points at the top. These are arranged so that the central point only acts until the bolster is near the limit of its swing. The bearing is then transferred to one of the lateral points, thus suddenly increasing the lever arm  $n$  (Fig. 4) by the distance from the central to the lateral point of suspension. With this arrangement no lateral springs are required.

## WHY IT IS HARD TO GET GOOD CAR INSPECTORS\*

BY J. H. HARRIGAN

Southern Pacific Company, Sacramento, Cal.

The demand for competent car inspectors exceeds the supply. This is not surprising when the manner in which these men are secured is taken into consideration, together with the knowledge and qualifications necessary intelligently to perform this work.

An intelligent young man, beyond the age when he can become apprenticed to a well-paying trade, out of a job and willing to do anything, applies for a position. If he is placed on the shop tracks car repairing, he will in time become familiar with details entering into car construction from the top of the rail to the running board. Further, if he has shown by his industry and ability that he is worthy of something better and indicates a willingness to qualify as car inspector, he is placed at air brake work and by close application becomes conversant with the principles governing air brake operation. He is now ready for the train yard, his duties as he passes through the various stages of development embracing the proper care of journals and journal boxes as relates to oiling, packing and re-brassing, repairs of such defective safety appliances as can be looked after in train yards, as well as air brake defects and other light repair work. After he has served at this work and has proved he is of the right stuff, he is promoted to the position of car inspector. This period of training should cover from two to three years, if he is to be thoroughly fitted for his work, which requires a working knowledge of the following subjects:

Car construction from top of rail to running board.  
 Air brake operation and repairs.  
 Safety appliances—standard application—penalty defects.  
 M. C. B. rules of interchange—delivering line and owners' responsibility—whether defects existing affect interchange.  
 Loading rules—recommended safe practice—width and height for clearance.

A car inspector must be somewhat of an executive, inasmuch as he has to arrive quickly at decisions and abide by his judgment. He cannot be vacillatory. His shop experience enables him to decide whether the defect is such as to affect the safety of the car movement and whether there will be less delay to repair it in the train or switch it to the repair tracks.

A car inspector must be honest and not indulge in sharp practice as regards repairs to foreign cars, but live strictly to the

\* Entered in the Car Inspectors' Competition, which closed October 1, 1915. For first prize article see November issue, page 575.

spirit of the M. C. B. rules, necessarily implying that he should have a working knowledge of such rules.

A car inspector should see that his employer obtains to the last farthing all the benefits of the labor and material used in making repairs to foreign equipment.

A car inspector must be a safe man; never taking any risks that would incur personal injury to himself or co-workers.

A car inspector must be thorough in his work. When going over a train he must not simply be a sight-seer, but assume the role of an investigator, examining closely the various details that affect the safety of operation. To do this he must bend his back and look underneath the car. Any carelessness in his inspection will show up in subsequent trouble and delay.

A car inspector should subscribe to some live periodical touching on mechanical matters relating to his branch of the work.

A car inspector when he shows he is capable of handling men, a vacancy occurring, is appointed a gang foreman, and as further opportunities present and he can qualify, he will be promoted accordingly. Here, as in every other human endeavor, promotion is not always rapid, but eventually ability will be recognized; if not, it has its reward in work faithfully done.

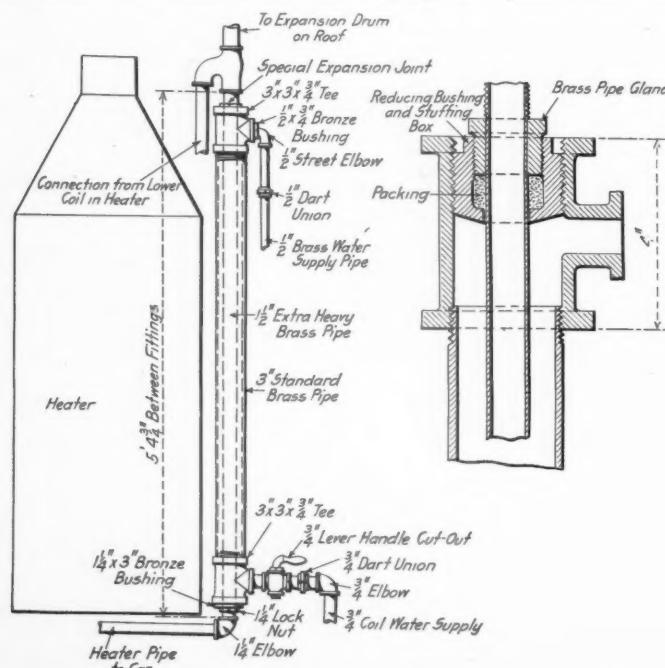
As to the decided lack of proper material from which to develop car inspectors, thorough in every branch of their work, I attribute this condition to the following two factors:

First, rate of pay is not commensurate with that received by employees in other branches of the railway service, ability and knowledge considered. Cost of living has advanced, but car inspectors are receiving practically the same pay as they earned 10 and 20 years ago.

Second, long hours of service, being obliged to work the 24 hours in two shifts. No doubt this condition is the survival of early railroad practice, it being assumed that, owing to the few trains handled, car inspectors were not employed continuously. In a large terminal yard to-day an inspector is on his feet every minute, every day in the week.

### EXPANSION JOINT FOR WATER HEATER

The drawing shows the method employed for heating the water for the wash basins in sleeping and parlor cars on



**Application and Detail Construction of Expansion Joint for Water Heater on Canadian Northern Sleeping and Parlor Cars**

the Canadian Northern. The unusual feature of this arrangement consists in the application of a special expansion joint which does away with the trouble previously experienced from

leaky joints caused by unequal expansion, which is difficult to take care of when a complete screwed joint arrangement is used. The construction of the expansion joint is clearly shown in the engraving. It consists of a 3 in. by 3 in. by 3/4 in. tee, one end of which is screwed to the 3 in. pipe, while the other end contains a reducing bushing and stuffing box through which the 1 1/2 in. pipe passes, provision being made against leakage by the use of a brass pipe gland and packing. This arrangement was developed under the direction of A. L. Grabum, mechanical engineer, Canadian Northern, Toronto, Ont.

### "THE DOCTOR OF CARS"\*

BY G. C. SLARROW

**General Foreman Car Inspectors, Pennsylvania Railroad, Baltimore, Md.**

First of all, who and what is a car inspector? What relation has he to one of the greatest industries of the time? Outside of the movement of a car, or a train of cars, this man is entirely responsible at most times for all cars. He is held responsible for ordinary yard inspections covering all parts that are open to the very closest inspection, the only excusable defects being those hidden from ordinary inspection, commonly termed "concealed parts." He must be thoroughly familiar with all lading loaded in open cars, and, in a great many cases, discern bulged and irregular conditions brought about by the improper loading of closed cars. He is called upon to make inspections on the road, at stations and piers, or on individual, private and industrial sidings; such inspections covering the loading of both open and closed cars. The instructions with which a car inspector must be familiar are too numerous to mention, the most important being United States safety appliances requirements, M. C. B. rules of interchange, air brake and train air signal rules, book of rules (general), transportation of explosives and other dangerous articles, rules of loading, dimension book of cars and lading for clearance limits, fire regulations, etc. He is also required to pass a rigid examination on sight and hearing, as well as on air brakes. He must be familiar with all miscellaneous instructions issued from time to time pertaining to his work. This outlines pretty clearly the most important duties of a car inspector.

The car inspector's position is something like that of a doctor; the man carrying the hammer may be classed as a "doctor of cars." The doctor of medicine finds it essential to get all the knowledge he can about the anatomy of a human being before he attempts to practice upon them. In a sense it is just as essential that a car inspector know the physical weaknesses of a car before he attempts to fill the position of car inspector. The following method appears to be the best to familiarize himself with these weaknesses:

First of all, wherever possible, place the man in a position where he will become familiar with both freight and passenger cars. Have him understand that if he desires to hold the position of car inspector, he must familiarize himself with all the rules of the work, it being understood, of course, that he will first be employed as a car cleaner, car oiler, or car repairman. Have the applicant pass the sight and hearing examination and air brake examination while employed in the capacity of one of these classes and arrange to work him in the place of regular men off duty, and, wherever possible, with an older man. Have him understand that he can go to the gang leader for any information that he desires, and have the gang leader understand that he is to instruct the man as to his work. This will turn out competent car inspectors. It will generally be from two to four years before the man gets a regular position; during all this time he is fitting himself for it, and it goes without saying that when the opportunity presents itself he will be thoroughly familiar with the work. So much for the ordinary car inspection work.

Interchange work is a branch of the car inspection department

\* Entered in the Car Inspectors' Competition, which closed October 1, 1915. For first prize article see November issue, page 575.

that requires a man with a complete knowledge of the M. C. B. rules. A man with a short experience as car inspector cannot make good in such a position. Generally speaking, the position of interchange inspector pays better, as it carries with it more responsibility. There is no doubt but what there are a great many car inspectors who do not take any interest whatever in the interchange work from the fact that they do not come in contact with it, and the interchanging of cars is an added feature to the duties of an ordinary car inspector.

Seniority should not govern the appointment of an interchange inspector. It would seem rather that the appointment should be based on alertness and aspiration for that class of work. The first step in his development should be to familiarize himself with all the M. C. B. rules of interchange, etc., while he is working as an ordinary car inspector. He should be allowed to work in the place of regular men off duty at interchange points whenever possible; always at points where there is more than one interchange inspector stationed, which will insure the proper supervision of his work by an older interchange man. Both the gang leader and the older inspector should be instructed to watch the man's work and give him all the information they can concerning the duties. When a position is open for the man he should be placed at a point with an older man for a while until he is thoroughly familiar with interchange work.

The duties of a car inspector vary according to local conditions. In some cases they do nothing but inspect cars; in others they make repairs in the yards, where no repairmen are located. There are points where no oilers are located and the inspectors do all the oiling.

The chances are very remote for promotion, the only promotions open to car inspectors, as a general rule, being to positions as interchange inspectors and gang leaders. The difference in the compensation is slight. From experience I would say that about 8 per cent. of the car inspectors are promoted to one or the other of these positions during their time of service.

## PROPER HANDLING OF EQUIPMENT\*

BY E. E. BETTS

Superintendent Transportation, Chicago & North Western

It is generally admitted that the present practice for handling foreign cars by the transportation and mechanical departments results in great economic losses to the railroads. Under the present practice of using cars regardless of ownership it is of common occurrence that their absence from home lines is indefinitely prolonged. They run without proper mechanical attention from one road to another, their condition growing steadily worse until they become a menace to the safety of trains and dangerous to life and limb. They are then taken out of service. They may be patched up and sent limping home for the owner to rebuild or destroy, or, perhaps, that is done by the road having the old worn-out cripple in possession when it finally lies down and can go no farther, but in any event the results are the same—the owner pays the bill and is most injured by the practice of neglect.

A car absent from the home line, we will say six years (and that is not unusual), becomes afflicted with old defects, some of them owners' defects, others users' defects. The car is finally taken out of service, and is then offered in interchange to a road which is known in our parlance as the "home route." The home route line rejects the car on account of its condition, and, pending a settlement of the question as to who is responsible for its condition and should make the repairs, it is held at the interchange point until the per diem accruing thereon is frequently many times greater than the cost of the repairs would amount to.

In other cases, especially in large terminals like Chicago, the

\* Abstract of paper presented at the September meeting of the Western Railway Club. As explained by Mr. Betts, this paper was also presented to the General Superintendents' Association of Chicago as a report of a special committee, of which Mr. Betts was chairman, appointed to make a study of the handling of equipment.

failure to inspect and properly repair cars, and the attempt to pass them from one road to another in defective condition, create a heavy terminal expense where belt lines are used as intermediate links, and greatly increase the per diem earnings of idle and unserviceable cars.

The failure to keep cars in repair applies to all railroads in greater or less degrees. Probably no railroad is free from that charge. In some cases it is undoubtedly a studied policy; in others it is chargeable to a lack of facilities, indifference and carelessness of employees, and various other reasons, but in our judgment under any and all circumstances it is a mistaken policy, because the interests of railroads are linked together in this proposition so that what injuriously affects one injuriously affects all.

One of the fundamental principles of the Master Car Builders' rules is that, "Each railway company must give to foreign cars, while on its line, the same care as to inspection, oiling, packing, adjusting brakes and repairs that it gives to its own cars." This virtually makes the attention which a road gives to its own cars the standard it should give to foreign cars.

If this may be taken as a declaration of principles, it is open to construction by the individual, and is, therefore, of little or no value for the government of such interests as are combined in this proposition, and which the Master Car Builders' Association is supposed to protect and to properly provide for.

The Master Car Builders' rules make owners responsible for, and therefore chargeable with, the repairs to their cars necessitated by ordinary wear and tear in fair service, so that defect cards will not be required for any defects thus arising, and, if we are able to construe this rule properly, it is based on the idea that cars afflicted with defects that owners are responsible for may be returned to the owners for repair, and here we believe is the cause of all our difficulties where the mechanical department is involved, because it virtually permits railroads to avoid making repairs to cars and permits them to be sent home for that purpose. We believe this to be a fatal defect in the Master Car Builders' rules.

Box cars are loaded promiscuously by railroads which have no direct connections at Chicago. When they enter the Chicago territory, they are pooled, loaded anywhere and everywhere and their absence from owners covers long periods. Result—The cars lose the channels of "home" (no short-routing being permitted) except by circuitous routes resulting in excess mileage and the handling lines are unwilling to repair them, each railroad basing its justification for the refusal to repair cars upon the short period the cars are in its possession.

In large terminals like Chicago, some one should have arbitrary power to schedule cars for repairs under Rule 120 and check up to see that they are properly made—then the theory and practice under M. C. B. rules 1 and 120 become consistent and effective, and such box cars which have no direct connection with car owners' railroads will be repaired and placed in revenue service. Until a change is made along these lines, our difficulties will continue.

Another principle fully set forth in the Master Car Builders' rules is, that cars offered in interchange must be accepted if in safe and serviceable condition, the receiving road to be the judge. The owners must receive their own cars, when offered home for repairs, at any point on their line, subject to the provisions of the rules. This is indefinite. It confers a latitude upon the receiving line which everybody recognizes as being eminently proper, as naturally the right to determine the safety and serviceability of cars to suit the receiving line rests with itself, and from that decision there can be no appeal. It may refuse the car, and there the matter seems to hinge. There is no standard of principle in such a rule as that, and it can only result in endless disputes, bad delays, useless expense, and just as soon as you appeal from the decision of the receiving line you take away the right conferred by the rule, and the rule then becomes void and of no effect.

Illustrations are not wanting to show in the most emphatic

manner that the amount of unnecessary mileage incurred by railroads in moving cars in an opposite direction from home in order to get them home is almost beyond belief.

If we are to secure proper and unrestricted movement of cars, and be able to employ them to their fullest extent, they must be kept in repair by the mechanical department. This seems to be a simple proposition on paper, and, inasmuch as repairs that owners are responsible for can be charged with a profit, we believe, to the road making them, the work should be done, and we can see no reason why it is not, unless the question of facilities, labor, supply of materials and other mechanical disabilities make it impossible. Where that is the case the cheapest, best and most rational thing to do before the car becomes in a dilapidated condition is to send it home direct to the owners and let them repair it, and such a car should not be made to travel 2,000 or 3,000 miles in order to cover an intervening area of 100 miles or less.

The judgment of the mechanical department is accepted by the transportation department in all cases where the safety and serviceability of cars are concerned. At all interchange points rigid inspection should be maintained. Cars that are offered in interchange under load not in serviceable condition should be transferred, and the empty returned to the delivering road, but if the transfer of the shipment is impracticable, some arrangement should be made to send the car through to destination, provided that it is safe, and when unloaded at destination, if it is wanted for a return load, or a load in another direction, the road using the car should make all necessary repairs, or should return it to the road it was received from to be continued homeward so that the owner may make them.

Individuals will differ as to what is or is not a serviceable condition, and for that reason if it is possible to define it, in a general way, at least, it should be done. There should be a standard of excellence for a freight car which shall govern inspection, and a matter of such vital importance to the railroads should be regulated by well-defined mechanical rules.

The remedy for the troubles that afflict the car supply, the handling of cars so far as the transportation department is concerned, is to be found in the movements of empty cars in a homeward direction by the shortest and most direct route, the initials of the cars to be the ruling guide, no other marking, carding rules, or regulations being necessary.

#### RECOMMENDATIONS

The committee also offered a series of resolutions to be referred to the Master Car Builders' Association and to the special committee of 25 mechanical and transportation officers to be appointed by the president of the American Railway Association, in accordance with action taken at its recent meeting in New York. The resolutions urged that the Master Car Builders' Association considered the adoption of a standard of maintenance for all equipment offerable in interchange, and the elimination of an interpretation issued by the Master Car Builders' Association under date of January 1, 1915, in M. C. B. circular No. 16, under which, the committee declared, "loaded foreign cars may be delivered in bad order to a connection and by it hauled to destination, and eventually, regardless of the length of time, be returned empty to the delivering line, if in the same physical condition, thus defeating the intent of M. C. B. rules 1 and 2, which provide for repairs to such cars." The M. C. B. Association was also earnestly requested to take such further action as will make obligatory the handling of bad order cars strictly in accordance with the present terms of M. C. B. rules 1 and 2, and provide for the handling of bad order cars under the following principles:

Cars to be accepted in interchange, either loaded or empty, must conform to the standard of maintenance to be agreed upon.

A loaded car destined to a point within the limits of the terminal at which it is delivered, or a car which must be transferred on account of bad order (not complying with this standard of maintenance), must be accepted if safe to run and

carded with Bad-Order-Return-When-Empty cards, or bad-order transfer cards, to be returned empty to the delivering line.

A car not conforming to the standard of maintenance to be adopted, accepted by a receiving line, must be repaired by the unloading line when empty, or returned to its owner.

Cars belonging to roads with which delivering line has no connection must not be transferred by the receiving line in order to save per diem or avoid repairs, which may be made under load, when such cars are loaded in a homeward direction.

Another resolution referring to good order foreign cars stated that a condition has arisen whereby foreign cars are not handled in accordance with the present car service rules, that under these conditions, during a slump in business, foreign cars are back-hauled thousands of miles over the various circuitous routes the cars may have traversed under load in order to finally reach their home. The American Railway Association Committee was urged to consider the revision of the present car service rules along the following lines:

All equipment, except box cars, shall be considered as special to the line owning and shall be returned to the owners in home route and a penalty applied for any misuse sufficient in amount to make the diverting of a car prohibitive.

Box cars may be loaded in a homeward direction regardless of the route via which they were received.

Foreign box cars belonging to a direct connection must be delivered to and received by that connection, regardless of whence they came, except cars received in switch service.

All box cars of individual ownership must be accepted by owner at any junction point offered.

Foreign box cars belonging to a road with which the holding road has no connection must be loaded for home or in a homeward direction or into home territory, regardless of whence they come, with the exception of cars received in switch service. Foreign box cars may be returned to the delivering line empty if in a homeward direction, but not otherwise.

In the event there is absolutely no loading of any kind that will take a foreign box car loaded in a homeward direction, then provide a means whereby it may be short-routed empty.

Make a reciprocal arrangement whereby one road will haul cars for another empty and equalize on a mileage basis through the medium of some kind of a clearing house. Such an arrangement will provide that cars hauled empty will always be hauled in the right direction, instead of in the opposite direction.

*Discussion.*—After reading the paper Mr. Betts called attention to the expense entailed in shifting the bad-order cars about. In the Chicago territory 1,445 bad-order cars were returned to the delivering line on account of mechanical defects, at a cost of \$7 apiece, and 861 cars were offered that were not fit for load. In one year 29,779 loads were transferred in Chicago on account of the cars being in bad order and it is believed that most of the cars were loaded when in that condition. Records of certain bad-order cars show that they made 29 and 30 moves before they arrived home.

J. R. Cavanagh, superintendent car service, C., C., C. & St. L., presented a written discussion favoring a general car pool and the repairing of the cars in pool shops. He believed that such a pool, under the joint jurisdiction and supervision of the American Railway Association, the Master Car Builders' Association and the general traffic associations, would give good results.

A. E. Manchester, superintendent of motive power, C., M. & St. P., believed that too much repair work was being done to perpetuate certain classes of cars and that provision should be made whereby these cars not be allowed to leave the home line.

W. E. Symons called attention to the very small mileage the average freight cars make per day, believing that there is much to be done by the railroads in having the cars promptly unloaded and returned to service. He believed that the roads were not prepared to keep the cars in the condition recommended by Mr. Betts in his paper. J. J. Hennessey, master car builder, C., M. & St. P., agreed with Mr. Symons in this respect, and believed that the paper presented by Mr. Betts was too much of an ideal.

# SHOP PRACTICE

## RECLAIMING MATERIAL AT LOCAL SHOPS

BY E. A. MURRAY

Master Mechanic, Chesapeake & Ohio, Clifton Forge, Va.

The salvaging of scrap material has received a great deal of attention during the last two or three years, and the saving to be effected by repairing or reworking material which reaches the scrap yard is now quite generally appreciated. Much that has been written on this subject, however, has dealt with reclamation at the central scrap yard. There is much material which can be reworked at division points and placed in service without being collected at the central scrap yard and this phase of the problem has been given especial attention at the Clifton Forge shops of the Chesapeake & Ohio.

Both car and locomotive parts are handled, as well as considerable track material, and a number of special devices have been installed which are almost exclusively used in reclamation work. Of the car material, some is repaired and again placed in service, while other parts are reworked and made use of for other purposes. Freight car truck arch bars are gener-

ally removed because of cracks, and in some instances are removed in order to be replaced with heavier bars. At this point we use a number of switch engines, and find this material suitable for step brackets for the front and rear ends of switch engines. The surplus material of this kind is sent to the main shop, where it is rerolled into round iron.

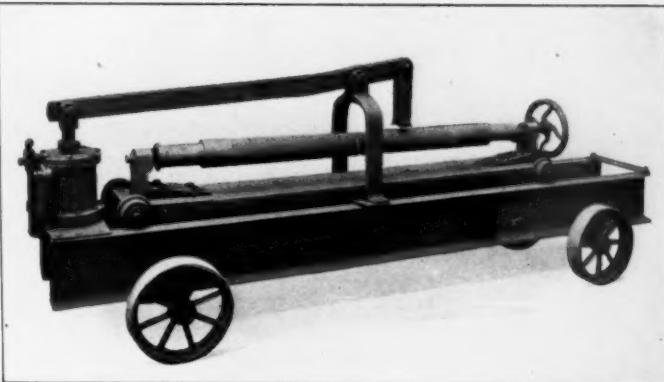
Metal roofing which is removed from cars is used for several purposes. It is converted into locomotive tinware, and has been found to give more satisfactory service than can be obtained from the tin, as it will withstand more rough treatment. It is also useful in repairing buildings which would otherwise require the use of corrugated iron. In some instances it has been used in siding up new buildings, the frames of which may have been made from old car sills, thus making it possible to build without requesting an appropriation. It has been found that a greater number of wooden sills are being removed now than heretofore, due to the use of heavy power and long trains with no perceptible increase in the strength of the cars. Aside from their use in the construction of new buildings, sheds, etc., the sills are of use in building platforms and repairing shop floors.

Practically all the old grab irons on cars fail to meet the requirements of the safety appliance standards of the Interstate Commerce Commission, and large quantities of them have been removed from cars which are unsuitable for further use as grab irons. This material is utilized in making rivets for steel car repairs, and it has been found that these rivets serve the pur-

pose as well as those made from new material. A large saving has been effected on this item alone.

Included in the car material which may be reclaimed and again used for its original purpose, may be mentioned couplers, coupler knuckle pins, cast iron car wheels, bent axles, brake beams, brake spreader rods, pressed steel oil boxes and springs, both coil and elliptic. Where the coupler is bent in the body or the knuckle pin holes are spread through the action of a broken knuckle pin, the coupler may be made serviceable again at a very small cost. Knuckle pins which have been bent are heated to a cherry red in an oil furnace, are examined for cracks or other defects and are then straightened and returned to service.

All cast iron car wheels which have been condemned and re-



Device for Straightening Bent Axles

ally removed because of cracks, and in some instances are removed in order to be replaced with heavier bars. At this point we use a number of switch engines, and find this material suitable for step brackets for the front and rear ends of switch engines. The surplus material of this kind is sent to the main shop, where it is rerolled into round iron.

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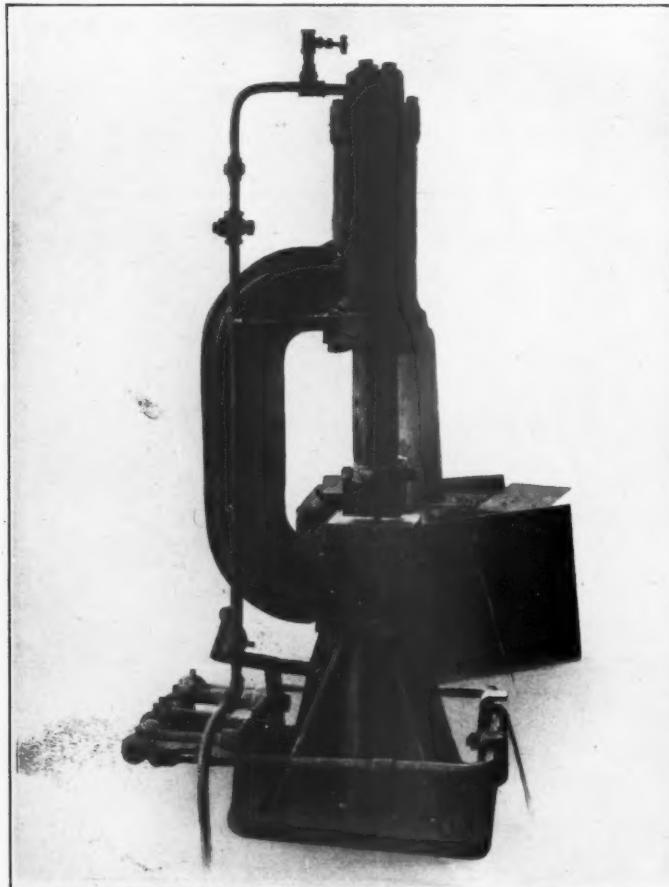


Hoist for Loading Scrap Wheels

moved because of flat spots, are shipped to the main shop, where they are ground at a cost of 45 cents each. One of the illustrations shows a pneumatic hoist used for loading these wheels and other scrap wheels. It is located close to the scrap wheel storage platform and enables a car to be loaded with wheels in a very short time. It consists of two cylinders, each 60 in. long, made up of five 10-in. brake cylinders placed end to end and held in position by six long bolts passing through heads of  $\frac{1}{2}$ -in. steel plate at either end. These cylinders are placed vertically in a pit and a platform .65 in. long by 37 in. wide is supported at the top of the 2-in. piston rods. Guide bars of  $\frac{3}{8}$ -in. by 3-in. iron are attached to the lower side of the platform near its ends and extend downward into the pit. The

operation of the device will be clearly understood from the illustration. The wheels are run onto the platform when at its lower position, in which it is flush with the scrap wheel platform. When loaded, the air is admitted to the cylinders and the platform raised to its upper position, in which it is close to the side of the car and flush with the floor.

Car axles which have been removed on account of being bent are taken to the blacksmith shop to be straightened in the machine illustrated herewith. This consists of a truck, the frame of which is made from two 3-in. by 12-in. channels each 12 ft. long. These are spaced  $13\frac{3}{4}$  in., back to back, and the upper flanges form the track for a carriage consisting of a 3-in. by 12-in. channel, placed flanges down, to the ends of which are secured axles carrying cast iron wheels 5 in. in diameter. To the carriage are secured two forged brackets, one of which carries a fixed center and the other an adjustable center. The axle to be straightened is placed between these centers after being heated at the point of the bend. To one end of the truck is secured an 8-in. brake cylinder, the piston of which is connected to the long arm of a lever pivoted in brackets secured to the truck frame. To the short end of the lever is attached a block, which may be brought against the axle at any desired point



Pneumatic Hammer Used in Reclaiming Track Spikes

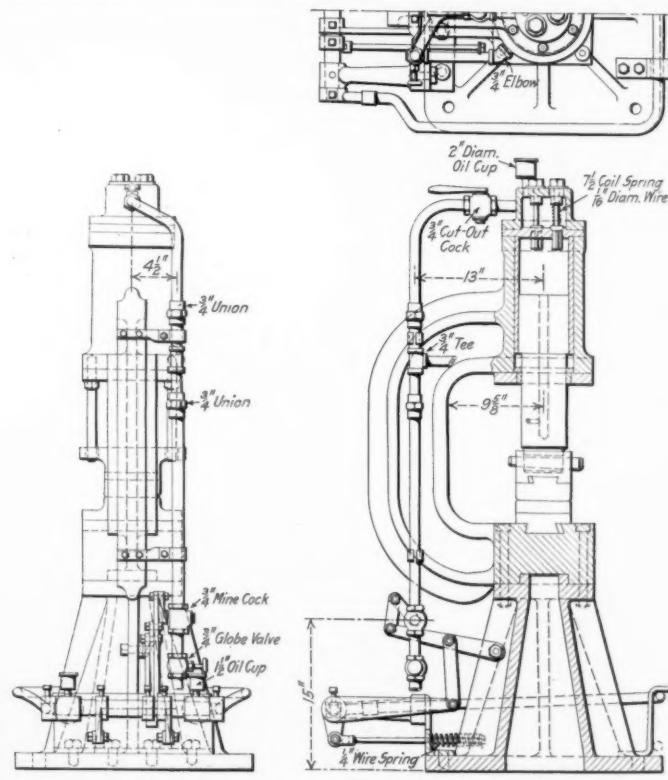
by adjusting the position of the carriage. The machine is operated by compressed air, and is portable. By its use axles are straightened without difficulty and at a very small cost.

The removal of brake beams is usually required because of worn brake heads or broken fulcrums, in most instances from the former cause. The beams are reclaimed by the application of new brake heads or fulcrums, as the case may be. One of the largest savings in car material is from this source. Another detail of the brake rigging which frequently fails is the brake spreader rod. These rods are usually made of cast steel, and failures occur at the jaws. Considerable saving has been effected by using two broken spreaders to make one good one. The spread-

ers are cut in two in the middle of the rod and a new spreader produced by welding together two good ends, the work being done in special dies under the steam hammer.

All bent pressed steel journal boxes are straightened and returned to service. Very few of these boxes are damaged beyond the possibility of repair, this being one of the best features of the pressed steel oil box.

Old locomotive boiler tubes, and air pipes removed from both locomotives and cars, unfit for further service need not be scrapped. The tubes form suitable material from which to manufacture washers. The tube is first flattened, after which the washers are punched out, making two washers with each revolution of the punching machine. Split keys may also be made in the same manner, and both the washers and keys give



Details of Construction of the Pneumatic Hammer

service equally as good as similar articles purchased from outside manufacturers.

Old air pipes which have deteriorated until they will no longer withstand pressure may be used for sand pipes on locomotives. The saving on this item is in itself not large; it is, however, worthy of attention.

Locomotive driving wheel tires which have been reduced in thickness to such an extent that they are unfit for further use in road service may be worn out on engines assigned to yard service, where the braking periods are not of too long duration and, therefore, do not cause the tires to heat and loosen on the center. This practice has been found very economical, as a sufficient supply of tires of the proper sizes are secured in this manner to practically meet the requirements of locomotives in yard service.

After engine truck and driving axles are removed because of worn journals they are placed in a furnace and thoroughly annealed. They are then given a close inspection for cracks and flaws and turned down for use on engines of lighter capacity, or, in the case of a main driving axle which is larger than the others, it may be used under the same class of engine for the front, intermediate or back, as the case may be. If axles are not suitable for use in this manner, they are sent to the smith shop, where they are converted into different classes of locomotive and car forgings.

A great many air brake hose are cut off where they are

chafed near the nipple, and the shorter lengths again fitted up to be used for shop purposes, such as making connections between the shop air line and the hose of portable tools, transfer tables, air hoists, etc. Air hose, which is of no further service as such, is used for locomotive sprinkler hose and for making water connections to the tender truck journal boxes.

Many globe valves have been thrown away which we have found it possible to put in good repair by renewing the disk, stem or packing nut. Often a valve which is apparently worthless may be made as good as new by reaming the seat and applying a new disk. This may often be done with the valve body in position in the pipe line, thus saving the expense of removing it. It will also eliminate the chance of distorting the valve body, often done in removing it from the pipes.

A large saving may be effected in the air brake department. Air pump pistons, which have been broken, may be welded and governor steam valves, feed valve pistons, etc., may be put in serviceable condition at a very small cost.

Inspirator bodies and lubricator bodies may be reclaimed by bushing the connections in the bodies where the threads have been stripped.

Nuts and bolts are reclaimed by retapping the nuts and straightening and rechasing the threads of the bolts. In some cases the bolts are cut off to a shorter length and rethreaded. Track spikes are picked up over the division and shipped to the shop, where they are sorted, the bent ones being straightened and worked over to be returned to service. Those which are badly deteriorated are scrapped. The pneumatic hammer, shown in the illustration, is used in this work, and has proved very efficient, as it requires but one person to operate it. It was built in the shop at this point at a very small cost. The air supply to the cylinder is controlled by a plug cock operated by a foot lever, the reversal of the plunger being automatically controlled by means of the poppet valves in the cylinder head and the exhaust port through the piston rod.

## THE APPRENTICE SCHOOL\*

BY R. J. HETTENBAUGH

Apprentice Instructor, Big Four Shops, Mt. Carmel, Ill.

"I am not getting a show," is a very common expression among the apprentice boys in the shop to-day. In a great many shops the company depends on the machinists to instruct the boy, but the machinist is not always inclined to tell everything he knows and the company has no idea what the boy is learning outside of his daily work.

This difficulty has been overcome in quite a number of the larger shops by employing instructors, whose duty it is to help the apprentice over difficulties and teach him how to set up work, sharpen tools and get the highest possible efficiency out of the machine he may be running.

This cannot be considered an extra expense for the boy becomes more valuable to the company early in his course through the help of the instructor and school work; otherwise he will drift along and can only learn by careful watching, and from a year and a half to two years pass before he becomes proficient enough to be of any value.

The greatest step that has ever been taken towards making efficient mechanics has been the installation of the apprentice school. Every boy is put through a general course in drawing and mathematics regardless of the trade he may be learning. This prepares him for the school course he is to follow.

Each boy spends four hours a week in school and is given full time according to his rate in the shop. In addition to this he is required to work from 25 to 50 problems a month at home. These problems all pertain to practical shop work and are a help in his shop studies.

\* Entered in the competition on "How Can I Help the Apprentice?" which closed September 1.

The merits of the apprentice system are evident from the fact that from 12 to 15 per cent of the boys serving time in schools with which I have had experience are now holding salaried positions with the company, and from 50 to 75 per cent are still in the shops.

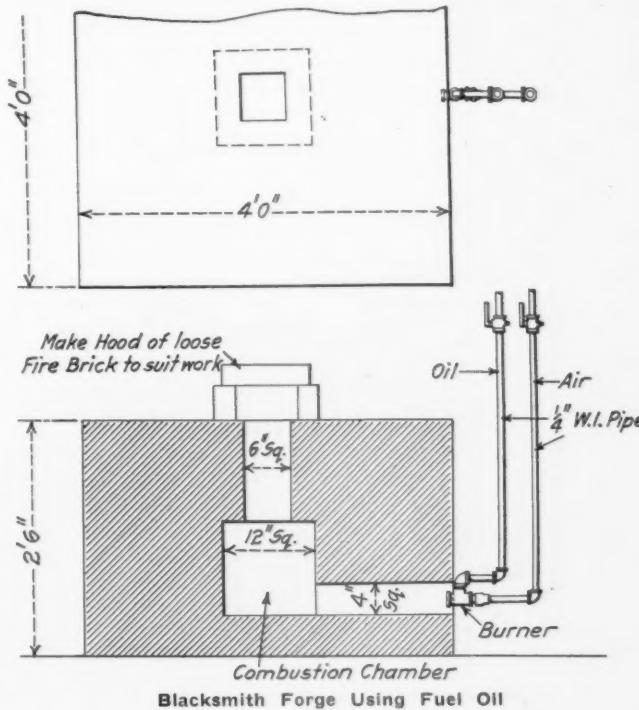
## OIL-BURNING BLACKSMITH FORGE

BY F. G. LISTER

Mechanical Engineer, Spokane, Portland & Seattle, Portland, Ore.

The blacksmith shop at the Vancouver (Washington) shops of the Spokane, Portland & Seattle is equipped with oil-burning forges which have proved entirely satisfactory, the fuel oil even possessing a number of advantages over coal or coke for this class of service. The burners are the same as that described in connection with an oil-burning sand-dryer on page 407 of the August issue of the *Railway Age Gazette, Mechanical Edition*.

A standard size forge is built of fire brick with a combustion chamber and delivery passageway as shown in the illustration. The burner is inserted at the mouth of the horizontal passage-



way, the flame striking the wall of the combustion chamber, from which it is diverted upward to the work. A hood of fire brick to suit the type of work to be handled is laid over the fire, which may be made to cover a very small or a very large piece of metal, as required.

Oil as a fuel for use in a forge is especially convenient and economical. The fire is always clean and is ready when needed, without the unsatisfactory expenditure of time in building and keeping it up. About twenty-five per cent more work can be turned out than with a coal or coke fire. This is partly due to the fact that the oil fire covers a greater heating area than either a coal or a coke fire, causing the piece in the fire to heat very rapidly, and the heat penetrates at an even temperature, avoiding any possibility of the outside of the metal burning before it is hot at the center. Coal or coke usually contains either sulphur or phosphorus, either of which, when absorbed by the iron, is detrimental to its quality. Coal burns very rapidly and in many cases contains too much non-combustible matter to give a free-burning, clean fire. These impurities do not exist in oil and no labor is required to convey the

fuel from storage to the forges or to clean out the cinders and ashes.

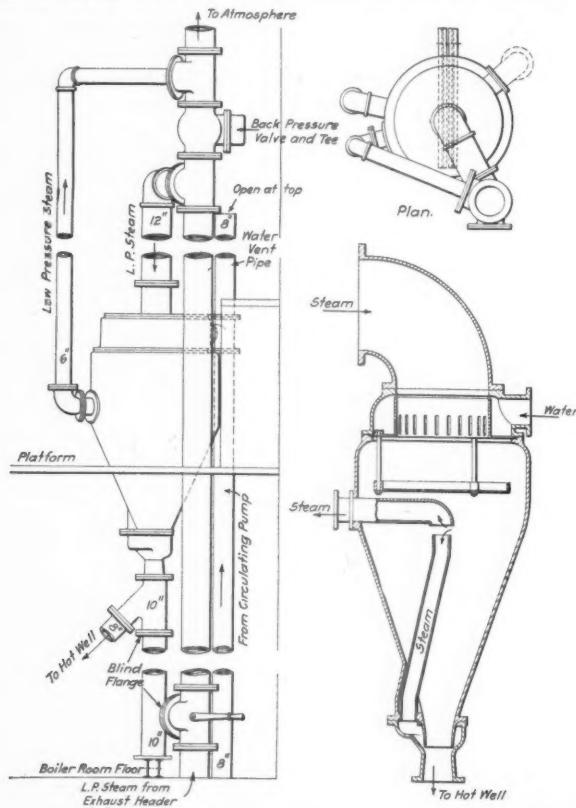
A pressure of air at 20 lb. per sq. in. is used against the oil to atomize and carry it to the work. The oil may be fed to the burner by gravity or by syphoning, the latter method being the most satisfactory, as the flow of the oil automatically stops should the air be cut off from any cause.

The work which is being done on these forges ranges from the tempering of tools to the welding of locomotive frames. Running continuously for a period of eight hours, a forge will consume about 18 gallons of oil.

## BAROMETRIC CONDENSER AS AN OPEN WATER HEATER

BY D. P. MORRISON  
Electrical Engineer, Pittsburgh & Lake Erie, Pittsburgh, Pa.

In modern railway power houses the supplying of hot water for roundhouse and similar uses, forms an important part of the service of the plant. The heating and circulating system usually is made up of the following elements: A hot well of ample capacity, a heater through which water from the hot well is passed by means of a circulating pump and a pressure pump taking its supply from the heater discharge or from the hot well.



Barometric Condenser Installed as a Water Heater on the  
Pittsburgh & Lake Erie

The heater is generally of the closed type, the water passing through the tubes, around the outside of which is steam from the power house exhaust main or from the tank into which the locomotives are blown off.

In one of the plants of the Pittsburgh & Lake Erie there was installed a heater with 2,300 sq. ft. of heating surface which could be kept in efficient condition only by a large expenditure of time and labor, as the tubes scaled rapidly and seriously. In addition to this, their life was reduced by pitting to less than three years. To get away from these two evils and on account of the necessity for immediate retubing, it was decided to abandon this heater entirely and in its place to install one of the open type.

For this purpose there was selected a barometric condenser cone with a capacity of 20,000 lb. of steam per hour at the usual condenser rating. The reasons for this selection were the lower first cost, the smaller space occupied and simpler internal construction, resulting in less interference on account of scale deposits. On account of the nature of the service the absence of an oil separator, usually a part of open heaters, was not detrimental.

This heater was installed without materially changing the piping or other apparatus. The circulating pump, which is of the single stage volute type, motor-driven, draws from the hot well and delivers to the regular injection water nozzle of the condenser, the tail water nozzle being connected to the hot well pipe. The steam enters the cone at the top through the standard nozzle and a pipe is led out to the atmosphere from the vacuum pump connection in order to prevent any building up of steam pressure in the cone in case the back pressure valve should fail to open. The circulating pump lifting capacity is slightly in excess of the height of the steam inlet connection, and it was necessary to provide against the possibility of flooding the exhaust steam stack in case the water tray and orifice at the top of the cone should become closed with scale. This was accomplished by extending the water pipe vertically a short distance beyond the injection nozzle connection, the extension terminating in an open end just below the connection between the exhaust steam line and the top of the heater.

This equipment has been successful from the outset, and since its installation two identical units have been installed for similar use in other plants. With the old type of heater, cleaning of the tubes every six weeks was imperative. The new equipment gave full service for two years before requiring cleaning, which took but a few hours. The operating results have been equally good, the water temperature being maintained at a high point only limited by the amount of steam available. Tests made to determine the heating capacity show that, given a sufficient amount of steam, the heater will supply demands very materially in excess of the present requirements.

In testing the heater, the hot well was filled with cold water and after the circulating pump was started the temperature was noted at intervals until the temperature of the circulating pump discharge had risen to 200 deg. F. The total amount of water heated was 21,115 gal., or 176,500 lb. at 63 deg. F. The table shows the temperature of the water and the rise in temperature as recorded at intervals during the four hours of the test:

Elapsed time, minutes	Water temperature, deg. F.	Rise in temperature, deg. F.
0	63	0
60	128	65
120	172	109
155	192	129
240	200	137

During the entire period a total of 24,180,000 B.t.u. were transferred to the water, an average of 6,045,000 B.t.u. an hour. For the first two-hour period an average of 9,619,000 B.t.u. an hour were transferred. Based on actual tests with the old heater, 3,000 sq. ft. of heating surface would have been required in a closed heater to have reached the performance of the first two hours. These figures are roughly checked by comparison with the temperature rise in the heater. The water was passed through the heater by the circulating pump at the rate of 8,250 lb. per minute and the average difference in temperature of the water entering and leaving the heater was 25 deg. F., thus indicating a heat transfer at the rate of 207,000 B.t.u. per minute.

It is evident that based on the results in the first and second hours, the heater has a capacity much in excess of the requirement. It is believed, however, that with the fluctuating steam-supply and water demand the large capacity over the average requirements is fully justified.

This type of apparatus will hardly prove successful in the absence of a hot well and circulating system, but where these are installed, the cost of a heater of this type will be at least 50 per cent less than that of a standard open heater, and 75 per cent less than that of a closed heater.

# THE BOILER INSPECTOR AND HIS JOB

## Prize Article and One Other from Boiler Inspection Competition Which Closed November 1

Ten papers were submitted in the boiler inspection competition, the first prize of \$35 being awarded to T. T. Ryan. His article and one other follow:

### FIRST PRIZE ARTICLE

BY T. T. RYAN

**Roundhouse Foreman, Atchison, Topeka & Santa Fe, La Junta, Colorado**

Successful locomotive boiler inspection, to meet the federal requirements, involves three important factors:

First, the selection of the inspector.

Second, criticising, encouraging and supporting him.

Third, providing him with the necessary paraphernalia properly to conduct the work.

The first thing to consider in the selection of the inspector is

FEDERAL INSPECTION REFERENCE								
Division _____			Month of _____					
Year _____								
Engine Number	Out of Service Stored in Good Condition		Inspection Dates			Remarks		
	From	To	Last Annual	Last	This Month			
Blank			4-27-15	9-25	24			
Blank	5-18-14	2-2-15*	5-8-14	9-5	5	*Advance test and flue renewal 8 months		
Blank						Receiving general repairs at _____		
Blank	(3-20-14) (7-2-15) (6-6-15)*	(Date)	*3-3-14	8-2-15		*Hydrostatic date 3-3-16. Renew flues by 3-3-17		
Blank	8-13-14	12-9-14*	7-30-14 10-23-15	9-24	23	*Advance test and flue dates 3 Mo.		

Record of Monthly and Annual Inspection dates

his ability as a mechanic. He should be a practical boilermaker and a competent judge of mechanical work, as under the widening scope of an inspector's duties he must often be a judge of work other than that directly pertaining to the construction of

RECORD OF FLUES AND LAGGING AND FIREBOX DATES						
Engine Number	Flues			Lagging Applied Barrel of Boiler	Firebox Renewed	
	Date Applied	New	Spliced			
Blank	4-17-13		198-All	4-17-13	4-17-13	
Blank	7-17-15	351-All		7-17-15	New back and front flue sheets and new door sheet 7-17-15	

Record Showing the Condition of Fireboxes and Flues and Date of Last Lagging Removal

a boiler. If he can have technical training as well, so much the better, but the former is the more necessary.

The second thing to consider is his ability diplomatically to handle men and situations. One may say that an inspector should not have to be diplomatic in getting the necessary work done; and in a sense that is true, but the fact remains that the successful inspectors are those who have the tact to fit the disagreeable duties of their position in so smoothly that they will not cause friction with the various foremen.

The inspector must also appreciate the routine and forms of office work fully in order to keep a complete and neat record of his work, and he should, by all means, be a man who can truthfully, fairly and creditably represent the company in case legal controversies should involve him as a witness.

The man selected should therefore be a practical mechanic who has an inflexible will that will enable him to insist on a given thing being done, who can fully grasp the importance and the necessary method of recording and accounting. Combined with these qualities he should possess the personal qualities that will make him *persona grata* at the court of approval in the minds of earnest fellow workers.

### BACKING HIM UP

Next we come to the difficult task of criticising, encouraging and supporting him. Assuming that he is in a roundhouse, the roundhouse foreman should follow closely the results he is attaining and point out how his methods may be improved, how his dates of inspection can be arranged to move steadily along without requiring overtime or having a group of engines out

BROKEN, FRACTURED AND DEFECTIVE						
STAYBOLT CARD						
Engine _____						
Flues applied					7-28-14	
Hydrostatic test					7-28-14	
Hydrostatic test					9-12-15	
7-28-14	All	Topeka,	New firebox			
8-7-14	None	La J.,	L U G			
9-3-14	None	La J.,	In service			
10-3-14	None	La J.				
11-4-14	None	La J.,	Special			
12-12-14	None	La J.				
1-6-15	2	La J.,	45			
2-15-15	None	La J.				
3-10-15	None	La J.				
4-11-15	None	La J.				
4-24-15	None	La J.	L U G			
6-5-15	None	La J.,	In service			
6-14-15	None	La J.,	L U G			
8-27-15	None	La J.,	In service			

Record of Staybolt Inspections and Renewals

of service at one time, thereby crippling the division. He should be encouraged to strive to attain more nearly to the ideal of perfection day by day, being satisfied with nothing short of a condition 100 per cent perfect. I might add that "A few flowers for the living that are usually saved for the dead" would go a long way to encourage him.

How do we support this man whom we have chosen for his special qualifications? This is the keystone of the arch. I want to include under this head the machinery and equipment inspector, for under the present scope of Federal law both inspectors go hand in hand. In the past they have been too often like the nameless knight who in the words of the poor

palmer in the banquet hall at Rotherwood, describing the scenes at Acre, "assumed into that honorable company more to fill up their number rather than to aid their enterprise."

Too often there has been an inspector more for the purpose of saying that engines had been inspected, rather than seeing that the work was done. Too long the respect paid to an inspector's report has been scant indeed, and too often the remark, "that is only that fool inspector's report," accompanied the consignment of his work slip to the firebox or the pit; when this was done by the foreman one could expect but little from the workmen.

Supporting an inspector consists in investing him with an authority that is absolute, and in this way, and this way only, will work be done promptly and in a thorough workmanlike manner.

As the foreman is the men are, and if that infernal phrase, "That's good enough," falls with favor on the foreman's ears you can be sure the workman will put up a class of work that measures to that standard, despite the fact that the very term, "It is good enough," implies there is something wrong, and known by all concerned to be wrong. It is easier and cheaper to maintain locomotives in a high state of perfection than it is to maintain a low standard.

We can best support the inspector in the roundhouse by doing the work he finds and doing it when he finds it, and not doing it four or five times to get it done right once.

Generally speaking there is as much time to do a job in a roundhouse one day as there is another, and we should impress on all the fact that there is in a roundhouse only one way to do a job, and that is the right way; there is only one time to do a job, and that is now.

#### FACILITIES AND METHODS

I will now outline a plan of inspection which works well with a minimum of trouble or attention. The forms shown are hypo-

STAYBOLT, STEAM GAGE AND SAFETY VALVE BOARD				
Date _____	Year _____			
Shop				
Engine	Staybolts	Water Glass & Gage Cocks	Steam Gage	Safety Valves

Daily Bulletin of Engines Due for Inspection

thetical cases arranged to show how to take care of monthly staybolt inspections; special staybolt inspections which are made by two inspectors if at the end of four months no bolts have been found broken; hydrostatic tests; flue records; record of lagging, and age of firebox. This information is filed in the numerical order of the engines on an ordinary Yawman & Erbe file with a sheet for each engine. The monthly staybolt reports are made from this file and sent to the mechanical superintendent, and the general and assistant general boiler inspector. All special information is shown on this form and may be ascertained at a glance at any time. This record is complete for four years, and the time consumed in locating the information when wanted has not exceeded five minutes per week.

A staybolt record is also kept, a card being arranged, as shown, to contain a record for two years. At the top is the engine number. The first line shows the date the flues were

applied, the second the date of the previous hydrostatic test and the third the date of the last hydrostatic test. The next date shows when and where staybolts were applied and the age of the firebox. The subsequent dates show dates of inspections, how many bolts were removed, whether the engine was in service or L U G (laid up in good order), special inspections, place of inspection and the number of the monthly staybolt diagram. This last number is assigned to the diagram and it is filed for ready reference. These cards are filed for the engines in numerical order.

A record is thus maintained by which the exact condition of every engine, firebox, flues, staybolts, age of flues and whether new or pieced, age and condition of firebox, dates of monthly inspections, hydrostatic tests, special inspections and dates lagging was removed from boiler, is known, as completed in the past and due in the future. These are kept in numerical and date order and are absolutely correct and up to date, affording the inspector a means of checking his inspections as they fall due

ARCH TUBE RECORD				
Engine _____				
Date	Flue	Workman	Inspector	Cause of Removal

Form of Page from the Arch Tube Record Book

and making it possible to keep in touch with the despatcher, and provide for inspecting the engines without overtime. During one month recently 100 engines were inspected without overtime on a division where most of the freight engines arrive at the terminal in the evening and depart in the morning.

As a further aid a board is placed in the roundhouse as outlined and each morning the inspector marks on it the numbers of the engines to be inspected, and indicates in the column set aside for this purpose whether or not the pops are to be set and the gages tested. The workmen assigned to the task of washing boilers and attending to gages and pops check this board and ask no questions, but get busy at once.

The arch tube record is kept in a record book ruled and headed in accordance with the accompanying outline, one page to each engine assigned to the division and arranged in numerical order. At the end of a year each page shows the actual record of the arch tubes applied during the year, the workman's name who applied them, the inspector's name who inspected them, when the work was done and the cause for removal.

There may be better ways to help an inspector, but these methods give an eminent degree of satisfaction and entail little trouble or expense.

The secret of success, however, with any method lies in perfecting a system that will automatically take care of the work and having the foremen and workmen respect the necessity of doing the work which has been reported by an inspector who is chosen and assigned to his duties because of his competence and common sense.

#### FACILITIES AND METHODS OF WORKING

BY W. J. GILLESPIE  
Boiler Inspector, Pittsburgh & Lake Erie, McKee's Rocks, Pa.

The system adopted after careful study, and the facilities that are given to the inspectors for carrying on the work of locomotive boiler inspection, in accordance with the rules and regulations of the Interstate Commerce Commission, and the methods

employed for keeping of data by the Pittsburgh & Lake Erie are specially good, and are roughly as follows:

#### THE INSPECTOR'S QUARTERS

The main shops of this road are at McKee's Rocks, Pa., just over the city line from Pittsburgh. A modern 30-stall roundhouse is here maintained; at about the center of the circle and abutting the roundhouse is the toolroom, 60 ft. by 30 ft. Here, centrally located so that he can easily reach any part of the house, the boiler inspector has been provided with quarters. The furnishing consists of a locker large enough to hold a change of clothing, overalls, and such tools as are necessary in the performance of his duties; a writing desk with a drawer to hold his ledger, blank inspection forms, etc.; and a bench on which is placed the steam gage tester. Facilities are also provided for cleaning up and washing.

#### ROUNHOUSE EQUIPMENT

The roundhouse is equipped with the Raymer blow-off and hot water system. On the wall, and between each stall, are six valves that control the blow-off, live steam, hot, cold and superheated water, and the high pressure test line. The supply pipe from these valves runs back overhead between the stalls and is dropped to about 6½ feet from the floor at a point that brings it easily within reach for connection to the side or front blow-off cock in the boiler. A pressure of 100 lb. is maintained on steam and water lines. The high pressure test line is worked independently by a pump that is used for this purpose; to use this line the inspector notifies the power house of the pressure desired and the pump is regulated accordingly.

Beside the toolroom window in the roundhouse hangs the daily bulletin board, also the daily work slate, the bulletin board showing the locomotive, number of train to which it is assigned, and time it is due to leave the roundhouse. The work slate governs the work of the water-tender, boilerwasher, flue-blower, boilermaker, cabman and firelighter. The first column shows the locomotive number and a column is also devoted to each of the aforesaid items in the order mentioned. As each completes the work that is required of him he marks O. K. in the column that is assigned to his work, opposite to the number of the locomotive on which the work was done.

#### METHODS EMPLOYED FOR KEEPING DATA

On the 1st of January of each year a bulletin sheet is laid off in 13 columns. In the first column all locomotives are shown by numbers, and in the order of the numbers. The 12 remaining columns are each headed with a month of the year. When the boiler has been given the regular monthly inspection the date is marked opposite the locomotive number and in the column assigned to the month in which the work is done. Should a hydrostatic test be made at this time, the letter H is added to the date of the month. In case the inspection has been made at a divisional point other than McKee's Rocks, a message is received giving this information and the record is marked on the bulletin in the usual way. Thus we are always in touch with the progress of the work and a glance at the bulletin is all that is necessary to find the date on which any locomotive boiler on the entire system is due for monthly inspection or hydrostatic test.

A bulletin of this kind is kept by the filing clerk in the office of the assistant superintendent of motive power, and another is hung in the office of the roundhouse foreman. In addition on the first of each month all boiler inspectors are furnished a list of locomotives that are due to have a hydrostatic test made during the current month, giving the dates on which they are due for the tests. They are also furnished on the first of each year with a list of those locomotives that are due to have all flues removed from the boiler; also those that are due for a five-year test, or the stripping of the entire boiler shell and firebox. The month and date are shown on which

it is necessary to have the locomotive removed from service to perform this work. These lists are furnished by the filing clerk and are attached to a bulletin board which the inspector has for this purpose and which hangs beside his desk. He thus has all this data beforehand and is saved the time and trouble that would otherwise be necessary in hunting it up after the locomotive had arrived in the roundhouse.

At the time that the hydrostatic test is applied—once each year—all caps are removed and exterior inspection of flexible staybolts is made. As a state law requires this work to be done once every 16 months, the delay to the locomotive is avoided that would otherwise occur in having it removed from service four months later in order to have this work performed.

#### OUTLINE OF INSPECTION WORK

Each morning a clerk in the office of the roundhouse foreman goes over the inspection bulletin sheet and makes out a list in duplicate of all locomotives that are due for monthly inspection during the next 24 hours. One copy of this list is delivered to the foreman in charge at the ashpit, and the other is placed alongside the work slate in the roundhouse. When a locomotive arrives at the ashpit the foreman, by consulting his list, can tell if it be due for boiler inspection, in which case he sees that the fire is dumped before it is sent to the house. On delivery at the roundhouse the hostler marks the number in its place on the work slate, and the floor foreman, by consulting the list which is placed alongside of the slate, is informed of the fact that the locomotive is due for boiler inspection and marks the letters S. T., signifying staybolt test, after the number of the locomotive. This for the information of the boiler inspector, cab workmen and boiler washers.

Should the firebox be equipped with a brick arch, the inspector orders all brick removed. In the meantime the water-tender has made the connection between the feed pipe and the blow-off cock in the boiler; after opening up the latter he also opens up the blow-off valve at the wall and all water and steam are blown from the boiler to a tank at the power house, where the water is delivered to the sewer, and the steam is used for heating purposes. When the boiler is emptied the blow-off valve is closed and the hot water valve is opened; when the boiler is filled it will be under 100-lb. pressure and is ready for inspection.

First, the exterior of boiler and firebox are examined as thoroughly as possible; tell-tale holes are inspected, and mud-ring corners and the interior of the front end are examined for leaks. Next the interior inspection of the firebox is made. Staybolts and radials are tested; flues, arch tubes, seams, grates and rests examined; and all defects are marked with the inspector's red chalk and a record is made in his note book.

The boiler is then ready for the boiler washers and cab workmen. If the repairs necessary will delay the locomotive beyond the time it is marked for departure on the bulletin board, the inspector immediately notifies the roundhouse foreman. He also furnishes the boiler shop foreman with a written report of all defects noted, so the necessary men may be assigned to make the repairs.

The work of the inspector does not end in chalk-marking defects. He must follow up the repair work and see that it is done in a proper manner. If staybolts are renewed he should see that there is a full thread in both sheets after the holes are tapped out; also examine all staybolts before they are applied to be sure that they are properly threaded and not ragged and torn; see that they fit properly when applied, that they are properly driven and that tell-tale holes are drilled to the proper depth. This applies also to all classes of repairs.

Should the boiler be due for a hydrostatic test the method of procedure is as follows: When water and steam are blown out, and it is being refilled, the inspector has the lagging and jacket removed from the firebox, has the steam gage removed and tested, and the steam pipe connection to the gage removed

and blown out, examines the steam cock to it and sees that the opening is clear, after which the gage is replaced. When the stripping of the firebox has been completed and the inspector has adjusted the clamps to the safety valves and the boiler is filled with water, it is ready for testing. The inspector then notifies the power house of the pressure he desires on the test line—always 25 per cent above the boiler working pressure. By opening the valve that controls the test line this pressure is recorded on the gage and is maintained until the inspection has been completed in the same manner as previously described, except that at this time it is good practice to have all grates and rests removed from the firebox in order that the bottom corners and sheets that are behind them may be thoroughly inspected.

When this part of the inspection is completed and the boiler is emptied, the dome cap and throttle box are removed and the interior of the boiler is inspected as thoroughly as is possible from above the flues; the sling stays or crown bars, cross stays and crown bolts are examined, also the front and back braces to see that all pins and keys are in place. The latter are also struck with the hammer to make sure they are sound and taut. The flues are examined for signs of pitting, and the shell sheets and joint seams as far as possible for pitting or grooving.

When the inspector has satisfied himself that the interior of the boiler is in good condition he reports accordingly and the throttle is ground in and replaced and the dome is closed. The caps having been removed from the flexible staybolts, the inspector proceeds with the inspection in the following manner: On the firebox end he strikes each bolt a sharp blow with a heavy hand hammer, going over all bolts in the box. When this is done he proceeds to the outside of the firebox. Here he uses a cape chisel, which is placed against the head of the bolt and struck with the hammer for the purpose of jarring it. After being struck on the firebox end, if the bolt is broken, it will loosen up in the sleeve and on being jarred on the outside as described, will turn around, and is easily detected. When all bolts are thus inspected and replacements are made, the caps are replaced, and after cab work is finished the boiler is again filled up and the working pressure applied. After the inspector has assured himself that everything is in good condition he so reports and the lagging and jacket are applied, the boiler is washed and is ready for firing up.

Where hydrostatic tests are made at various points on the line which do not have the above-mentioned power-house facilities, the boiler inspectors are provided with force pumps. These are converted from locomotive air pumps, the lower chambers of which are removed and replaced with 4-in. cylinders, intake and outlet with necessary connections, regulator attachments to govern the air pressure in the chambers, and air hose connections. These pumps are placed on small trucks and firmly braced and are easily moved to any location in the roundhouse and placed alongside of the boiler that is to be tested. When the boiler is filled with water the blow-off cock is closed and the pump is connected thereto. The supply line is connected to the pump, and the air hose is connected and air turned on; the supply line and blow-off cocks are opened and the pump is placed in operation; the regulator is adjusted until the desired pressure is obtained. This is maintained until the inspection is completed.

In all cases the boiler-washer reports to the inspector after he has finished washing out the boiler; the latter examines the boiler to see that the work has been properly done. To aid them in making this inspection all boiler inspectors are furnished with flashlights about 6 in. long, which are easily carried in the pocket. By inserting this light in the plug holes on the backhead above the crown sheet a clear view may be had between stays from back to front of the crown sheet; then by placing it in each plug hole along both sides of the crown a thorough inspection of the entire surface may be made. Using the plug holes on each side of the firedoor the water leg can

be examined between staybolts for the entire length of the firebox; by using the bottom corner plug holes in this way it can be seen whether all scale and deposits have been washed from the mudring across the front and back and along both sides. The interiors of the arch tubes are examined to see that all scale has been removed therefrom.

At the time that this inspection is made after boiler washing, the work of the cab men is also inspected; the gage cock and water glass cock spindles are removed and the openings examined; the steam gage is removed and tested, and the steam pipe to the gage is removed and blown out before the gage is replaced. When the boiler is fired and the working steam pressure is raised, the inspector sees the safety valves set, tries water glass cocks, gage cocks and both injectors.

When satisfied that these are in good working condition he fills out the inspection form, and after having it signed by the officer in charge, places it in the locomotive cab, after which the forms for filing are filled out and taken before the notary and sworn to and placed in the hands of the filing clerk.

#### IN CONCLUSION

The annual bulletin sheet renders it impossible for any locomotive to become overdue for boiler inspection without its being known. And the monthly and annual lists that are furnished the boiler inspectors by the filing clerk are ample for their needs and leave them the time that would otherwise be taken from that part of their work, which is of more vital importance—the keeping of the locomotive boiler and firebox in good serviceable condition. The inspector's quarters should be as centrally located as possible. Provide him with a locker to hold his change of clothing; locate it where the clothes which he takes off in the evening will have a chance to dry out before he puts them on in the morning. Furnish him with a writing desk with drawer, and also facilities for washing.

His inspection forms when filed must be clean and free from finger marks. The drawer will keep the blank forms clean, and by washing his hands he can avoid the finger marks, but not by rubbing them off with a piece of waste. He should be provided with a ledger in which to keep a list of the locomotives and in which to make note of all repairs that are made to the boilers and fireboxes from time to time, also making note of their general condition after each inspection. This will enable him to reply intelligently when his superior asks for information as to the condition of any locomotive boiler or firebox that may come under his jurisdiction.

**TIRE HEATER.**—An economical and effective tire heater in use on the Great Northern at the Dale street shops, is made from  $\frac{1}{2}$ -in. gas pipe, there being two coils superimposed on each other and connected at one end by a return bend welded to both coils. The outside coil is used for vaporizing the oil, which in this case is kerosene. The second, or inside coil, is perforated with  $\frac{3}{64}$ -in. holes spaced  $2\frac{1}{2}$  in. apart. Small legs about 1 in. long are welded to the pipe to properly space it from the tire. The oil is forced into the coils from the reservoir tank by air pressure, and on starting it is vaporized by the application of a gasoline torch to the outside of the pipe. This heater is easy to construct, and by the use of kerosene reduces the cost of operation and provides greater safety.

**Two Good SUGGESTIONS.**—In a paper presented in the competition on "How Can I Help the Apprentice?" which closed September 1, the following suggestions were made by John Paska, Chicago:

The apprentice should have a day each month to do anything pertaining to his trade and the work done on that day should be strictly examined and judged.

His master should give him a chance to see many things which pertain to his trade, and, if possible, have him make an excursion after a year or half year to some other important shop.

# "HOW THE OLD MAN BEAT THEM TO IT"

An Experience with an Efficiency Engineer in  
a Railroad Shop Plant, and What Came of It

BY HARVEY DE WITT WOLCOMB

"Old Dan" Keefe, the popular superintendent of the locomotive and car repair shops of the R. S. & P. at Wonderly, was "up a tree." He had been fighting against the installation of a shop efficiency system in his shops and had apparently put up such good arguments against the so-called "new fangled" idea, as he termed it, that the very words "shop efficiency" were never spoken in his presence. But this morning he had received, in his mail, a personal letter from the vice-president and general manager advising that an "efficiency engineer" was on his way to Wonderly to make a personal check of the shop conditions, with a view of establishing a "shop efficiency" system.

## "UP AGAINST IT"

Poor Old Dan had to read the letter through twice before he could make himself realize that the management had at last "called his bluff," and that his days of absolute power were past. Now, Dan was one of the few remaining mechanics of "the old school" and had fought his way from the ranks up to the highest position by hard work. He had been superintendent so long that he, like every one else, regarded himself as a permanent fixture and had begun to think the railroad could not run without him. In fact, during his administration the shops had made several notable records and these, together with his low cost of repairs to equipment, had been one of his best arguments against the efficiency system. But now it was all over and "Old Dan" could see far enough into the future to realize that one of the first moves the new efficiency engineer would make would be to secure the appointment of a younger and more modern superintendent.

The very thought of being called a "has been" fairly made him sick. How dear everything looked in the office; the chair he was sitting in at his desk was given him by the management in recognition of a special service he had rendered, and, at that time, he had been given to understand his services were indispensable; but now it was all over. As he recalled his past service, the fighting spirit of his Irish nature tempted him to put up a last fight for his position, but then on the other hand, his good common sense showed him that he was too old to fight against such great odds as the management's wishes and a young efficiency engineer who was just starting out in life, anxious to succeed at any cost, so the best thing to do would be to take "his medicine" like a man.

In his own mind he pictured the new engineer as probably being a clerk in some railroad office that had had no real shop experience, but had taken up the "mail course" study of efficiency as a side line and had gotten so swelled up over what he thought he could do that he had dazzled the general manager into giving "his system" a try out.

## THE EFFICIENCY ENGINEER ARRIVES

Well, there was no use of crying over "spilled milk," so Dan started out through the shops to have one last loving look at the old place.

As Dan started through the pattern shop he detected the odor of cigarette smoke. Now, if there was one thing that made the "Old Man" "fly off the handle" it was cigarette smoking; then again he was a great "stickler" for shop rules and one of his strongest rules prohibited smoking in the pattern shop. Personal feelings were forgotten immediately in the hunt for the guilty man, and when Dan found that the transgressor was not one of his workmen, but a total stranger, who even had the nerve to light a fresh cigarette while looking directly at one of the many large signs that prohibited smoking in that department,

he was so "wrathy" that for once he could not even "cuss."

The stranger, a young man about 30 years of age, mistaking old Dan's silence for timidity, added fresh fuel to his anger by remarking that in all his experience he had never seen such a glaring example of shop *inefficiency* as the location of that pattern shop so far away from the foundry.

Say, was the "Old Man" hot? Does a bull get mad at a red flag? Well, I don't know how a bull feels when he sees a red flag, but I do know that the "Old Man" had taken a lot of pains to locate and build that very pattern shop just where it now stood, and it was one of the "soft" spots in his heart; and to have a young whip-snapper "sneer" about his good judgment was such a shock to the "Old Man's" nature that his anger overcame his mental ability, and from force of habit he blurted out, "Well, what's the matter with this shop; speak up, my man?"

Instantly "Old Dan" would gladly have swallowed those words, for he didn't want to talk like that; he wanted to fight. But the damage was done, and the young man being anxious to talk, quickly answered that the pattern shop was too far from the foundry, and a great number of steps and valuable time were wasted daily from having to walk from shop to shop; "and," continued the young man, "one of the first things I do at this old plant will be to move this 'mess' over next to the foundry, where it belongs, cut out this unnecessary waste and put this business on an efficient basis."

## DAN SEES A LIGHT

Suddenly "Old Dan" seemed to see a great light. Here was a new phase of "efficiency" that he had never thought of. Just think of the net saving in moving a new \$40,000 pattern shop so as to save a few steps a day and at the same time provide a nice cozy loafing-place for the molders. Then again, just think how long it would be before that shop would burn down from sparks from the foundry, the same as the old shop did. The old blacksmith shop was another shop that would have to be moved also, for it was a little to one side of the plant, but as it was a large, roomy stone building, well ventilated and lighted, they had managed to get along with it in its present location. But Dan could see that from the "efficiency" standpoint, it caused him to waste a lot of steps in a year.

Dan's anger was all gone now. He was just the plain "foxy" Irishman that had so successfully run the plant for the past 20 years that the management was going to kick him out now and have a young greenhorn step in that didn't think any more about moving a \$40,000 building than some people would about moving a wheelbarrow out of their way. Well, the "Old Man" wasn't buried yet, and perhaps he could show them a thing or two.

After a few minutes' talk with the young man, Dan excused himself, saying that he had some mail to look over, and that he hoped the young man would stop in at the office before he left. The first thing "Old Dan" did after he got in his office was to give vent to his feelings by having a short war dance around his desk. Just think, when he left the office he had felt that his time had come, and he had gone out into the shop like an old worn-out horse; now he was actually dancing.

## DAN GETS BUSY

Dan rang the buzzer for his best stenographer and started to set the stage for the downfall of "shop efficiency" at the Wonderly shops. His instructions to his stenographer were to hide in the closet and to take down every word that the young

efficiency engineer said. "Be sure and copy correctly the figures he gives out," said Dan, "for I think perhaps I can use them to good advantage."

After a long wait, the efficiency engineer was ushered in, and while Dan apparently was very busy, he gave the young man a good looking over. "Well," said Dan, "what do you think of the place, and what are some of the many changes that should be made?"

"You have here a great chance to install my system," replied the young man, "for this is one of the worst places I have ever visited. Take, for instance, your method of wheeling engines. You are still using the old style drop pit, and I propose to take out these pits, install an electric crane and cut the cost of wheeling engines by half." "Very fine," replied Dan, "and what will an electric crane cost?" "About \$8,000 complete—that is what it cost the X. Y. & Z. people to make their installation," replied the efficiency engineer.

Well, to make a long story short, the young engineer was going to move the blacksmith shop, as Dan predicted, at an estimated cost of about \$25,000; move the pattern shop at a cost of about \$40,000; install an electric tram car track through the shop and equip all machines with individual motor drive, which would cost in the neighborhood of \$120,000. Besides he was to have a "supervisor of shop efficiency" and a "supervisor of shop routing" who would get salaries of about \$3,000 a year each. If Dan hadn't got hungry, I believe that young man would still be sitting in his office telling about the great things he was going to do, but Dan was getting sick of such "fairy-tales" and called a halt by going out to lunch.

#### "DAN KEEFE, EFFICIENCY EXPERT"

That afternoon "Old Dan" ordered some business cards printed that read like this: "Dan Keefe, Efficiency Expert," for he had thought of a plan whereby he could "put it all over" that young engineer, and not only have the pleasure of holding on to his job, but also of teaching the vice-president and general manager a lesson that would make him realize they couldn't pull any "rough stuff" as long as he was alive and kicking.

After giving the efficiency engineer a couple of days to render his report, "Old Dan" made a trip to headquarters to see the V.-P. and G. M. Of course, as everyone in the office knew him, they told him to "go right in" and see the "boss," but Dan insisted on sending in one of his new business cards in the regular manner, and of being presented the same as any other visitor. Dan's visit was at an opportune time, for the V.-P. and G. M. had just finished checking over the efficiency engineer's report, and the great amounts to be saved, as shown by this report, had made the "boss" sit up, and wonder how the old road had ever existed as long as it had.

As Dan went into the office, the "boss" did not greet him very enthusiastically, for he thought that "Old Dan" had come to plead for his job. But Dan quickly changed his opinion when he told him that he had quit, and was now in business for himself. "You see," said Dan, "times have changed, and business must be managed efficiently now to become a paying proposition. As superintendent of your plant for a long time, I have had a chance to study economy, and my experience with the average efficiency engineer is that they plan to 'save money at the spigot and waste it at the bung-hole,' so I am introducing a system where you do not have to invest large sums, but I will take 10 per cent of the money I save for you as my salary. Some of the greatest chances for efficiency are the small things that we do wrong every day and yet go unnoticed."

#### REAL VERSUS PAPER SAVINGS

At first the "boss" got mad, but when Dan offered to show two ideas to the other fellow's one, that would result in an actual saving for the company, the boss had to "sit up and take

notice." "In the first place," said Dan, "your efficiency expert will recommend the installation of an electric crane to wheel engines. This crane will cost you about \$8,000, and as we wheel about 20 engines a month, that investment will net you approximately \$500 a year, or about 6 per cent on your investment. On the other hand, we have a large plant to keep clean, and at the present time it is costing your company about \$60 a day to do this. With my system I propose to not only clean the entire place, but to keep all scrap picked up as well, by dividing the plant up into several districts and having a gang assigned to every district, from the figures I have here, the approximate cost for this work will be \$35 a day, or a net saving of \$25 per day, which means approximately \$7,500 a year.

"Take your present method of getting rid of the scrap wood in the car yard. You are burning it after picking it up and hauling it about a quarter of a mile. This all costs money, and I propose to have some old employees pick up the wood, saw it up into commercial lengths and sell it by the load to the families that burn wood. From the figures I have here this idea will net your company \$800 a year after paying the wages of your men doing this work.

Well, it wasn't very long before the "boss" saw that "Old Dan" had the goods to deliver, and he realized that where his efficiency engineer had reported that it would take an investment of over \$200,000 to make an "efficiency" saving of about \$20,000 a year, the "Old Man" was proving that this same amount could be saved without making any investment; so he told Dan to go back and prove his statements.

#### GETTING RESULTS

The rest of my story will have to go unfinished, for "Old Dan" is on the job every day now, and is working out new ideas all the time. A short time ago Dan said to me: "The older I get, the less I know, for at one time I was working my head off and now I am simply playing with the work. Now, I take one job at a time and study it from all sides to see how easily and cheaply it can be done. I started in with some old worn-out employees. Every large plant has some men that have worked all their lives for the company, and when they get old and worn-out, they cannot be fired, so it is necessary to give them light work they can handle. I took my old men and started some to taking care of scrap paper; others to picking up nuts and washers; others to selling scrap wood. I had each man keep an account of how much he made for the company. The first six months we paid eight of these men the sum of \$2,346 in wages, and they had picked up and reclaimed over \$3,000 worth of scrap material.

"I organized scrap inspection committees under my supervision and had the different foremen inspect each other's gangs with the result that the scrap shipped out of here has been reduced by over half.

"We encouraged the men in the shop to make suggestions for economy and offered a cash prize to any man that would make a suggestion by which we could save money. What do you think! The very first suggestion was by one of our common workmen, and he suggested that we use cast iron instead of brass for certain parts on the engines and cars. This one idea alone is saving our company thousands of dollars.

"Instead of buying new machines now, the foremen and men get their heads together and build a machine at much less cost that does the work just as well as an expensive tool. You can see for yourself the great number of home-made 'kinks' around the shops and yard.

"We take our men and foremen through the storehouse and show them how we keep books and what the material they are using costs. You don't see any men splitting nuts or breaking globe valves now, for they know what a new one costs and are anxious to help save money. Spoiled work is followed up closely, for that is one of the most expensive items on a railroad. When we find a careless workman that spoils

a lot of jobs, he is asked to get out, for we can't afford to have him around.

#### ECONOMY COMMITTEES

"Each department has its economy committee, composed of the regular workmen in that department, for we find that some men feel more free to talk and offer suggestions to their brother workmen than to the 'boss.' This committee has made some valuable suggestions, and as we offer a cash prize to any one who gets up a tool, or money-saving idea, we are getting the loyal support of every man.

"Take, for instance, the subject of keeping windows around the shop in good shape. It used to cost us an average of \$25 a month to keep new window glass in the frames, but the man who did the work got interested in the saving idea and showed us that by moving a few machines we could reduce the number of broken window glass. Our average cost per month now is under \$4, so you see that no matter what a man does, there is some chance for him to use his eyes.

"We had a machinist tell us that he lost about 25 per cent of his time waiting for his machine to stop after the power was shut off. You see, he was operating a high speed machine, and when we checked up his work we found that what he said was true, for he was on small work and had to start and stop his machine frequently. Another workman designed a simple brake by putting a short piece of belting over one of the steps on the cone pulley on the machine.

"One of our old drill press hands recommended that we place barrels of soapy water at convenient places in the shop to be used for drilling and cutting compound. We gave this job to an old employee, and he is more than saving his wages every month by keeping the barrels full. We not only save money on this material, but as it is so near the work, the men save steps and time in getting it.

"Another workman suggested that we use pieces of wrought iron pipe at several places in the plant where we were using rubber hose. This meant quite a saving in rubber hose, for after we installed the iron pipe we used shorter lengths of hose, and that gave us a supply of hose to last over eight months. In addition to putting in the iron pipe, that same workman has designed a flexible hose.

#### TRAINING A REAL EFFICIENCY ENGINEER

"And in conclusion," continued old Dan, "I know I am getting old, so instead of trying to take all the secrets of this plant to the grave with me, I am breaking in a bright young fellow to handle the place. In checking up the suggestions made by our workmen, I located this young man, and I have taken him into my office where I can train him to my ideas. The next time the vice-president or general manager wants to put in an efficiency engineer, I will have beaten him to it, for we have such a man now employed that I am training to my ideas, and even when I am through here, I will still be represented."

#### TAKE A REAL INTEREST IN THE APPRENTICE \*

BY A. MACCORKINDALE

Foreman, Meadows Shops, Pennsylvania Railroad, Jersey City, N. J.

"How about the apprentices in your shop?" In our shops every encouragement is offered to employees having eligible sons anxious to learn a trade. Investigation is made concerning the general make-up of the candidate and his intentions, not forgetting his educational tendencies. Before he is hired every necessary point of information is given him regarding the conditions under which he will have to work, his wages, etc.

"Are they given a fair chance?" Yes. And I answer without fear of contradiction. We must realize that the apprentice of to-day is the artisan of to-morrow. Our apprentices are not sent hither and thither with any Tom, Dick or Harry, but are

\*Entered in the competition on "How Can I Help the Apprentice?" which closed September 1.

placed under the care of high-class mechanics, so that they are insured the best of practical mechanical examples.

"Do they receive systematic and adequate training in their trades?" They do, and it is not the fault of the Pennsylvania Railroad if an apprentice fails to grasp the efficient system of which he is a part. He is continually told that if there is anything he wishes to know regarding the machinery or the work, to ask until the correct information is given him.

"What help or encouragement do you give them? Our master mechanic considers it a very important attribute towards being a good mechanic that a young man should be clean morally in spite of the oft-told tales that the best mechanics are generally rascals. It often happens that the high school boy who filed his application three years ago has changed his ideas of spending his leisure time. He used to march down the shop ready to work at the blow of the whistle, giving out a hearty "Good morning, sir," whereas now we see him repeatedly rushing from the car to the shop and arriving at the office with hardly enough breath left to ask for his card, and before he regains his normal state remarking to a dozen fellows: "Gee, I am tired," or "That car's late every morning." We frequently make our presence felt with that stamp of fellow.

Personally I never allow a chance to pass where our apprentices may be benefited, whether along mechanical, athletic or social lines. I have been successful in enrolling all the eligible apprentices in the Pennsylvania educational courses which provide free first-class information necessary for promotion. I use many lunch hours talking with them on theoretical and practical subjects, especially in their particular trades. Our Y. M. C. A. holds lunch hour meetings throughout the winter and in the absence of a professional speaker at several of these I was selected to speak, taking such subjects as "The Value of Study," "Technical Knowledge," "Influence of Associates," etc.

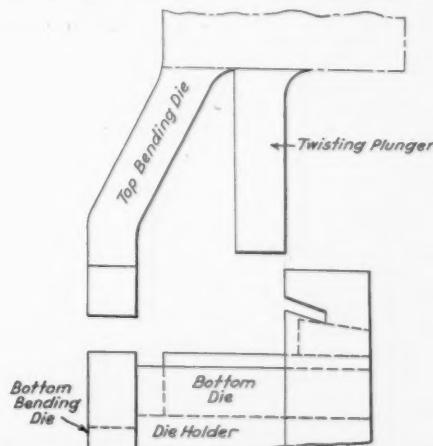
The following is considered an excellent schedule for machinist apprentices:

12 months.....	Machine shop
12 months.....	Erecting shop
3 months.....	Drawing room
2 months.....	Tin shop
2 months.....	Boiler shop
2 months.....	Blacksmith shop
9 months.....	Roundhouse
6 months.....	Finishing in erecting shop

#### DEVICE FOR FORMING SILL STEPS

BY JOHN TREACY  
Foreman, Smith Shop, Great Northern, St. Paul, Minn.

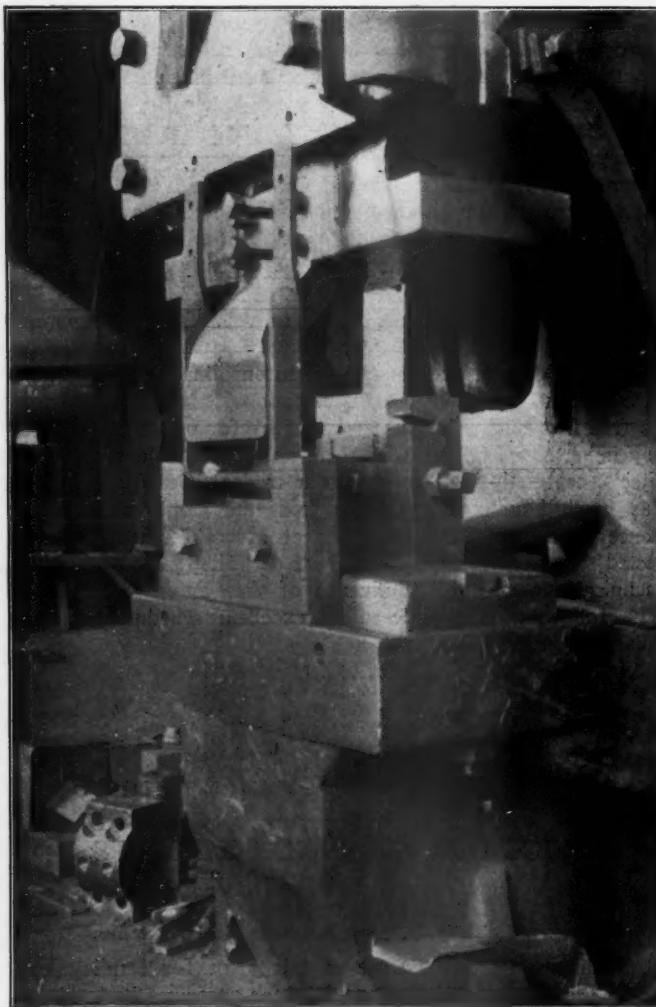
A combination die is in use at this point for bending and twisting the ends of sill steps cold, which performs both opera-



Relative Positions of the Bending and Twisting Dies

tions without the changing of dies. From the photograph it will be seen that there are two plungers, one to twist the ends of the material and the other to form the step. The lower twisting die is fitted with a slotted holder at one end

which prevents the end of the material from twisting, the remainder of the piece being supported on the die for about one-third of its width. The twisting plunger in its descent comes in contact with about one-half the width of the unsupported portion of the material. The piece is thus turned between the two dies to a right angle with the end in the grooved holder. After one end is twisted the material is reversed and the other end twisted in the same manner. The sketch is an end view of the device, showing the relative positions of the two plungers, both of which are attached to the same head. The plunger



Dies for Twisting and Bending Sill Steps

which forms the step is in front of the twisting plunger and its operation will be readily understood from the illustrations.

The iron is received in the blacksmith shop from the company's own rolling mill at St. Cloud, Minn., where it has been cut to length. It is delivered by the stores department and piled beside the machine within convenient reach of the operator. Each piece is placed in the grooved holder and moved along until the end strikes a gage which fixes the length of the twisted portion. After the pieces are twisted the steps are formed on the same machine, the use of a plunger to twist the ends making it unnecessary to change dies between the two operations. This device has greatly increased the output of sill steps and has materially reduced the cost.

**IGNITION TEMPERATURE OF COAL DUST.**—Coal dust ignites at temperatures about 750 deg. F., provided there is enough heat present to ignite a sufficient quantity for passing along the heat of combustion to adjacent particles so as to make the ignition continuous.—*Power.*

## HOW CAN I HELP THE APPRENTICE?\*

BY J. H. PITARD

Master Car Painter, Mobile & Ohio, Whistler, Ala.

Make an intelligent selection of material. Before a boy essays to learn a trade, he should have a fairly good common school education. This is necessary for the development of the mind to the extent that will enable a boy quickly to grasp shop practice problems as they arise. A boy's general appearance and deportment should also be considered, and his acceptance should be decided on only after the foreman has satisfied himself that the applicant combines in a satisfactory degree the necessary qualities of an apprentice.

The advent of the apprentice into the shop means to him the opening up of a new world, and naturally he is more or less timid and credulous. At this point his foreman, in the privacy of his office, should have a heart to heart talk with him, and in a general way outline the work that lies before him and endeavor to impress him with the necessity of being studious and attentive to his duties; also of being self-reliant, self-respecting and respectful to his foreman and shop associates. Be his real friend, and the boy will be impressed. The foreman should give him all the encouragement possible, and care should be taken that, under no circumstances, should the boy become "cowed." With a broken spirited boy progress is correspondingly slow. Rather encourage him to believe in himself—the stronger the better. This is a necessary trait, which when once acquired, will stand him in good stead throughout his entire life.

Nurse him as little as possible. He should be placed on his own resources as fast as his attainments will warrant. The custom of the mother eagle in pushing her brood over the precipice as soon as their wings will sustain their weight contains a lesson which, in a large measure, is applicable in the case of an apprentice.

Put him through the different stages of the work in proper order. He should not be permitted to take up the first part last, nor the last part first. He should be required to proceed in the same order that obtains in constructive procedure, and should be held at each stage of the work until he has mastered it thoroughly, both in principle and practice.

Prepare written questions bearing on the most essential points of the work as he passes from stage to stage. Require written replies, which should be corrected, and the errors explained in detail. By this means the depth of his comprehension can be gauged, and the proper instructions given on the points most needed.

Relieve him of shop drudgery that has no bearing on his trade, but properly belongs to the common laborer or shop sweeper.

Give him due praise when his work merits it, and administer needed reproof in a manner that corrects, but leaves no sting.

Do not forget that he is still a boy with all the characteristics of a boy, for which allowance should be made. The occasional demonstrations of a boy's surplus energy, although not altogether consistent with shop discipline, should not meet with reproof too severe; such energy should be utilized by directing it into useful and proper channels.

Show a friendly interest in the boy's home and private life. Get in touch with his parents or guardian, if possible, and co-operate with them in every way that is beneficial to the boy's upbuilding and welfare.

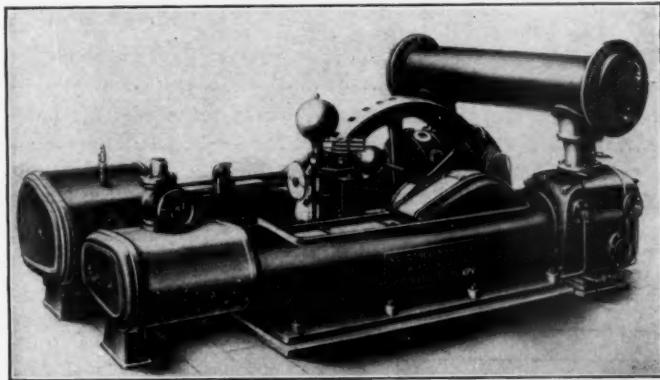
**LOCATING FLAWS IN METAL SURFACES.**—Cracks or flaws in a smooth metallic surface are rendered visible by thoroughly moistening the surface with kerosene and then rubbing and drying it with a clean cloth and subsequently rubbing over the surface with chalk. The location of flaws will then be revealed by traces of the kerosene coming out again from the cracks into the chalk surfacing.—*Power.*

\* Entered in the competition on "How Can I Help the Apprentice?" which closed September 1.

## NEW DEVICES

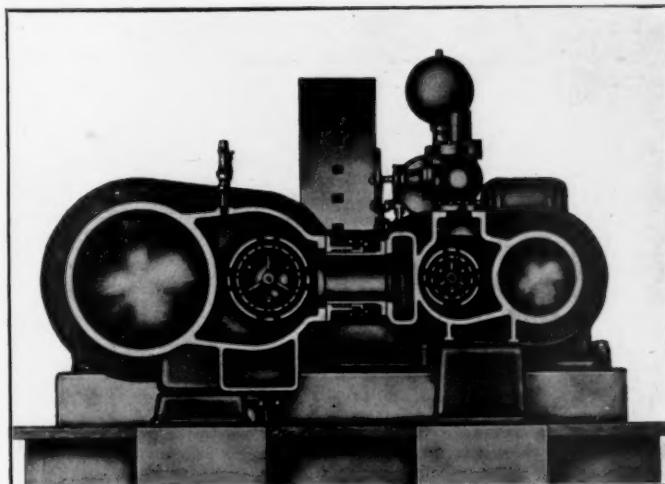
### PISTON VALVE WITH AUTOMATIC CUT-OFF FOR AIR COMPRESSORS

The slide steam valve in various forms has been standard on air compressor units below the sizes (about 25-in. stroke), where the use of the Corliss valve gear becomes commercially practicable. But the wider use of high pressure and superheated steam has made the use of the slide valve, even of the adjustable cut-off type, obsolete. At high temperatures it is very



Air Compressor with Piston Valves and Automatic Cut-Off Valves

unsatisfactory, due to its tendency to warp, with consequent leakage, and the difficulty of lubrication is also increased, which results in greater wear and greater force required to drive the valve. To provide a steam-driven air compressor which will operate satisfactorily with high pressures and superheat, as well as with moderate pressures, the Ingersoll-Rand Company, New York, has developed a balanced piston valve, which has been



Cross Section Through Cylinders, Valve Chambers and Receiver, Ingersoll-Rand Piston Valve Air Compressor

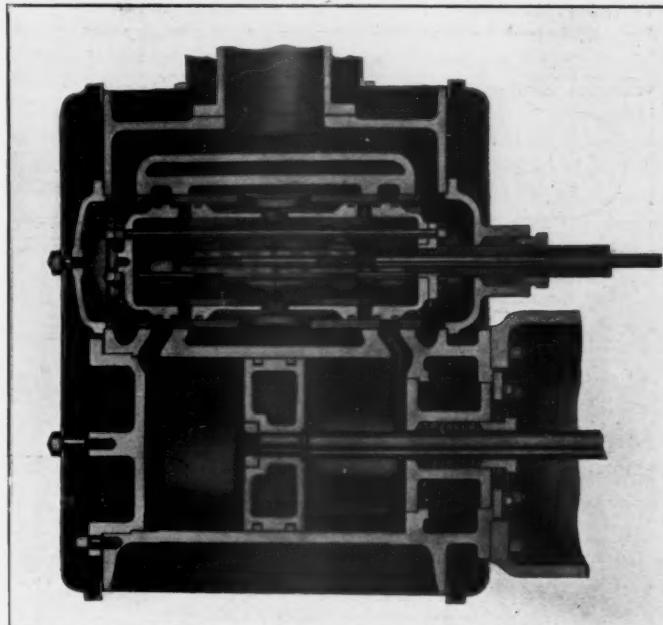
incorporated in the design of its line of standard Imperial duplex air compressors.

The use of a balanced valve makes it possible to control the machine by automatically varying the point of cut-off in the steam cylinders. This method of regulation maintains constant speed for changing steam pressures and at the same time varies the speed of operation to the demand for air. Steam is

always admitted to the steam cylinder at full boiler pressure and without the wire drawing of a governor or the throttling type. With the hand-adjusted cut-off valves, usually set at  $\frac{5}{8}$  or  $\frac{3}{4}$  stroke, the steam economy is admittedly poor, while with an automatic cut-off regulation a considerable saving in actual steam consumption is effected.

This piston valve is a perfectly balanced valve of the telescopic type. The cut-off valves are right and left-hand threaded to a cut-off valve stem, which enters the valve chamber and the valve through the center of the valve stem. Steam admission is through the center of the valve, the steam then passing through the valve ports to the cylinder and being exhausted by the ends of the valve. It should be noted that this construction exposes the valve chest covers and steam packings to exhaust pressure only, thus reducing the liability of leakage. The design and uniform distribution of metal in this piston valve are claimed to preclude any possibility of warping and to result in a valve so balanced that friction is minimized and lubrication facilitated.

The steam ports are large and unusually direct and special effort has been made to reduce the condensation surfaces in the cylinders. Exceptionally complete insulation, the separa-



Longitudinal Section Showing Balanced Piston Valve and Cut-Off Valves, Ingersoll-Rand Compressor

tion of live and exhaust steam passages and the fact that the steam chest partially encircles the cylinder, contribute to the steam economy. These features are clearly shown in the sectional illustrations. The cylinder and receiver lagging is covered with a sheet iron casing and that of the cylinder heads with neatly fitting cast covers.

The steam receiver is a direct connection between the high and low pressure steam chests. The low pressure chest is proportioned to furnish additional capacity and so located that the heat ordinarily lost by radiation is used in heating the cylinder and valve. A special expansion joint prevents any possibility of cylinder alignment being destroyed.

The governor is a speed and pressure regulator, which varies the cut-off by automatically rotating the cut-off valve stem

and changing the relative position of the cut-off valves. It is essentially a chain-driven rotary oil pump, which acts against a weighted plunger. The variation in oil pressure due to the changing speed of the compressor, or the varying air pressure acting against the plunger, changes the cut-off point in the steam cylinders.

This governor is entirely automatic in operation and is claimed to be capable of maintaining exceptionally reliable and close regulation.

Lubrication of both air and steam cylinders and valves is provided for by force feed oilers. The compressor of the new design, called the Imperial type XPV, are similar to those now in service, built by the same company. They include a wholly enclosed main frame containing the reciprocating parts, automatic lubrication by the bath system and completely water-jacketed air cylinders. They are built in capacities from 608 to 3,620 cu. ft. per minute and for discharge air pressures from 10 to 110 lb. per sq. in.

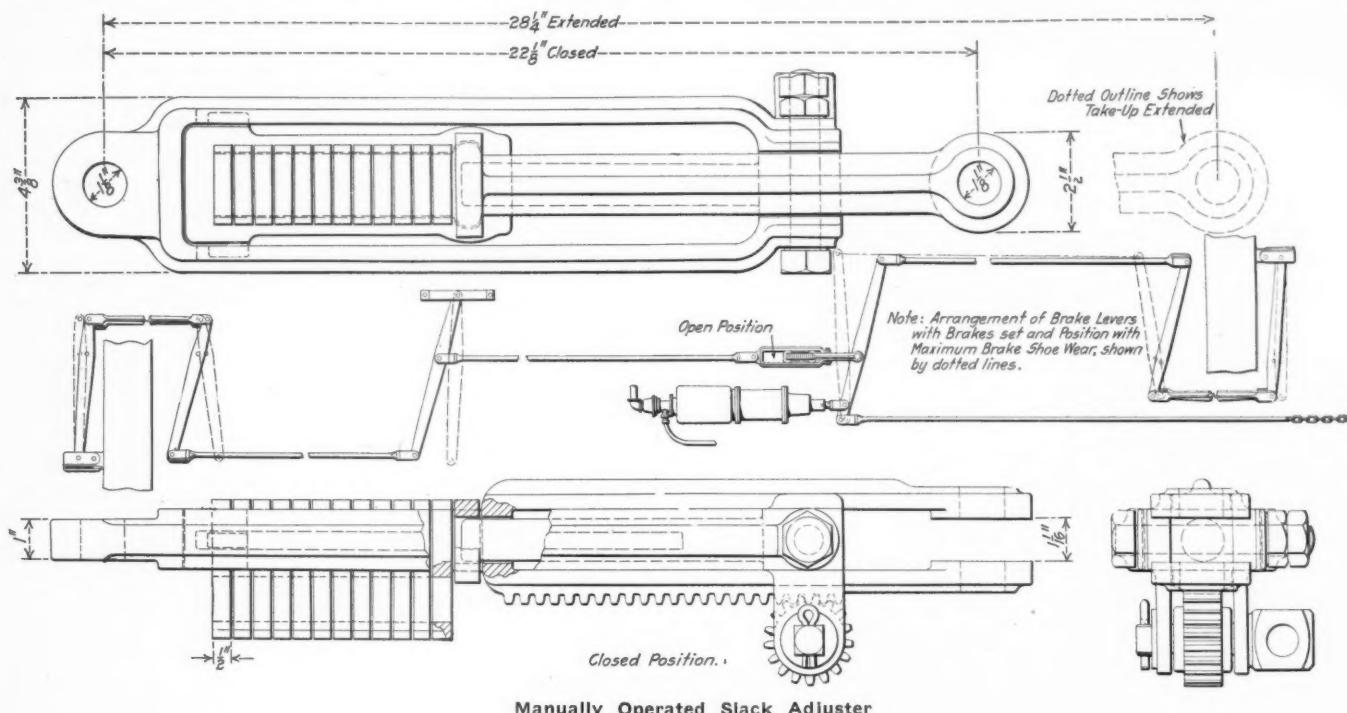
### MANUAL SLACK ADJUSTER FOR FREIGHT CARS

A manually operated slack adjuster for use on freight equipment has recently been placed on the market by the H. W. Johns-Manville Company, New York. The purpose of the device is to make it unnecessary to crawl under each truck in order to take up slack due to brake shoe wear, a task both dangerous and difficult of performance. The device is located in the

of the double yoke fit into grooves in the side of the body, thus holding the end of the yoke in position and guiding the relative movement of the two parts. The jaw at the open end of the body is closed by a block of rectangular section on the end of a thrust rod, the upper and lower faces of this block serving as a guide for the open end of the double yoke. The thrust rod, which is about 9 in. long, extends back on the center line of the body, and passes through the cored hole in the throat of the double yoke.

Within the closed part of the yoke are placed 12 thrust blocks, each one-half in. thick. The width of the opening between the sides of the yoke is increased at the throat to permit the passage of the retaining lugs on the ends of these blocks. A key block is inserted in this opening when the device is assembled and is locked by the thrust rod, which passes through a hole in the block. The thrust blocks have a length of 3 in. between the retaining lugs and through the lower end of each is a hole  $1\frac{1}{8}$  in. in diameter. When the blocks are raised until the lugs on the lower ends are brought in contact with the yoke these holes are in line with the thrust rod, thus permitting the yoke to be moved to the position shown by the broken lines in the drawing.

When slack is to be adjusted, the brakes are set lightly in order to show the piston travel. A pinion secured to the body meshes with a rack on one side of the yoke. By inserting a short bar in the capstan head of the pin which holds the pinion in place, the yoke may be moved back, thus shortening the length of the cylinder tie rod. As soon as the rod has been shortened one-half inch one of the thrust blocks will be released from the end of the thrust rod and will drop to its lower position by



Manually Operated Slack Adjuster

cylinder tie rod, where it is easily accessible, and but one adjustment is necessary for both trucks. The adjustment is made when the brakes are applied lightly so that correct piston travel may be obtained without trial adjustments.

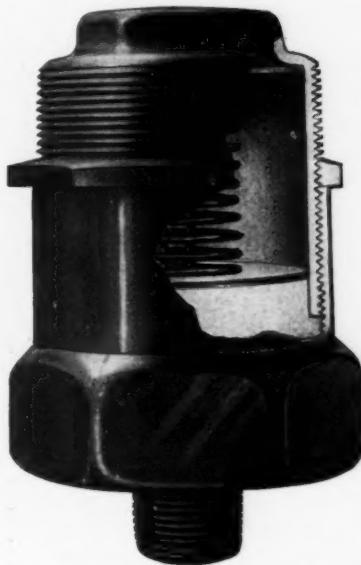
The location of the device in the brake rigging as well as its construction are shown in the drawing. Adjustment is effected between the body of the device and a double yoke sliding within the body. The body is a malleable iron casting about 18 in. long of yoke form, the closed end being provided with a tongue which is connected to the end of the tie rod. The double yoke consists of two parts, the sides of which are turned at right angles to each other. These two parts join at a throat through which is cored a hole  $1\frac{1}{8}$  in. in diameter. Lugs on the inner end

gravity. The other blocks follow successively for each succeeding one-half inch adjustment. In the lower position the solid portion of the block is opposed to the end of the thrust rod, thus preventing the return of the parts to the original position. The adjustment is continued till the piston travel has been shortened to standard. The total adjustment of 6 in. in the length of the rod provided by the device is sufficient to take care of maximum brake shoe wear.

**SCRAP IN A POWER HOUSE.**—A Chicago wrecking company recently salvaged about 2,000 tons of old iron and steel by the tearing down of the power house of the Philadelphia Rapid Transit Company.—*Power*.

### COMPRESSED AIR GREASE CUPS

A grease cup depending partially upon the action of compressed air to automatically feed the grease, has been developed by the Hunter Pressed Steel Company, Philadelphia, Pa. The device is designed primarily for use in stationary practice where it is claimed to require but little attention, adjustment once a week often being sufficient.



Construction of the Airspring Grease Cup

The device is manufactured from pressed steel and consists of the ordinary type of grease cup threaded on the inside, into which a light pressed steel cap is screwed. Within the cap is a light coil spring and flat disc which is pressed down upon the top of the grease and supplements the air pressure as well as serving to level the grease and distribute the pressure when first applying the cap. The air entrapped within the cap is compressed as the cap is screwed into place and sealed within the grease, and the action is entirely automatic. The disc and spring are easily removable from the cap and are reversible, it thus being impossible to improperly assemble the device. The cup is known as the Airspring Grease Cup and is furnished in four sizes for  $\frac{1}{2}$  oz., 1 oz., 3 oz., or 6 oz. of grease.

### CAST STEEL TRUCK SIDE FRAME

The drawing shows a recently developed cast steel truck side frame which has been adopted by the Pennsylvania Railroad. The

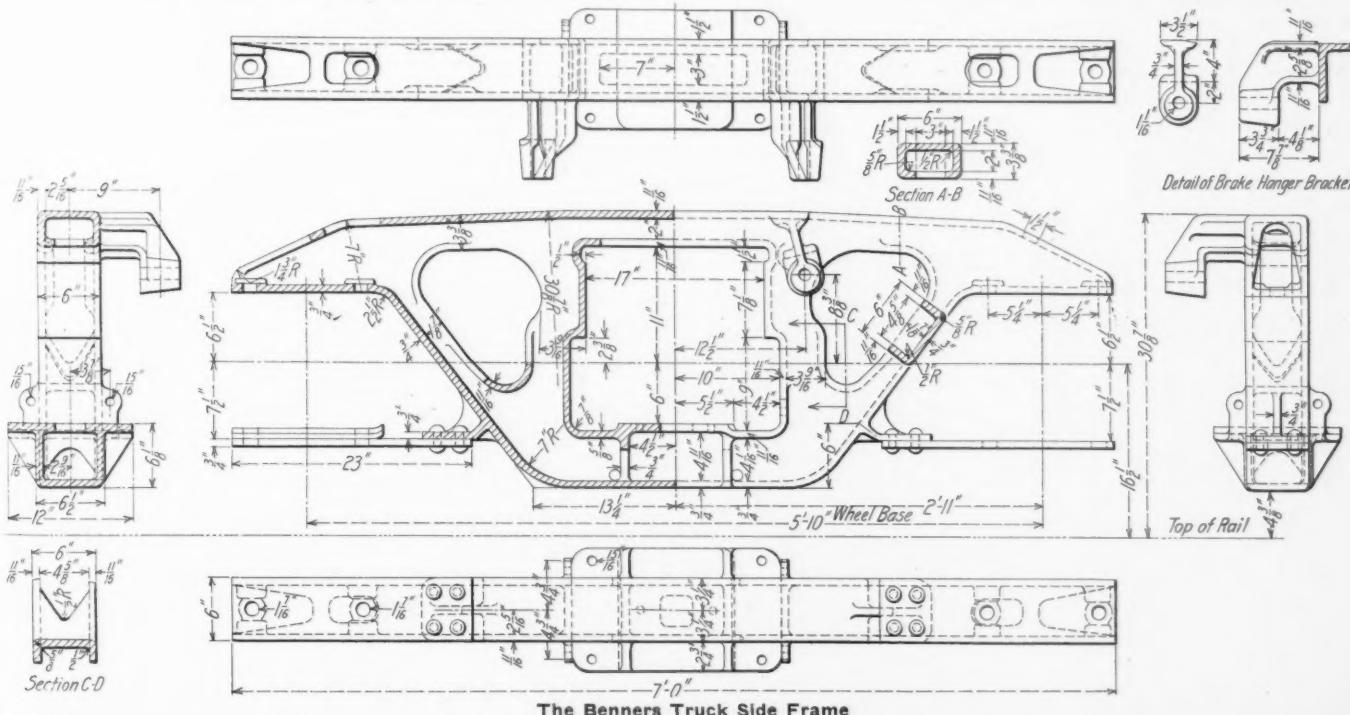
The distribution of metal has been carefully considered and a well balanced structure obtained, effecting a uniformity of flexibility under the action of the stresses due to both static and dynamic vertical loading.

Where unbalanced sections are used in the design of cast steel truck frames, the unequal strains set up in the metal, in cooling, result in a distortion of the casting. This distortion is corrected by placing the casting when cool under the straightening press, the result being that the metal at certain points is subjected to a stress beyond the elastic limit. Certain weak points are, therefore, developed in the casting at the outset, their strength being very uncertain. Cracks tend to start at these points, which result in the ultimate failure of the casting. The symmetrical and well balanced design of the Benners side frame is such that the castings come out of the sand in perfect shape and the use of the straightening press is entirely unnecessary.

The Benners frame has no outwardly extending flanges, such as are found in castings of angular or I-sections, which always tend to develop cracks at the edges. The use of re-entrant flanges brings the edge of the material nearer the neutral axis of the section, a point where the unit stress is considerably reduced.

After thorough tests of the Benners side frame, it has been adopted by the Pennsylvania Railroad and the Pennsylvania Lines West, now being in service under several thousand freight cars. The patents are controlled by Edward H. Benners, 50 Church Street, New York.

**STRENGTH OF AUTOGENOUS JOINTS.**—The strength of the joint produced by autogenous welding, it is pointed out in a paper on high-temperature flames in metal working, has been a fruitful source of discussion in the application of the process, and many contentions have been advanced as to the necessity of welds of highest tensile strength. It was early found that 100 per cent welds, or, in other words, those having a breaking strength equivalent to that of the metal itself, could be produced, but the sacrifice of elongation and reduction of area materially lessened the apparent value of such welds. Present practice is directed toward securing a weld of good tensile strength, as compared with the strength of the plate, with high ductility, since thereby the service conditions are better fulfilled. The growth in under-



principal feature of the design is the use of channel sections and channels with re-entrant flanges instead of angle and I-sections.

standing of such requirements has resulted in the production of methods which produce these results.—*American Machinist*.

# NEWS DEPARTMENT

The shops and roundhouse of the Chicago & Illinois Midland at Taylorville, Ill., were destroyed by fire November 4; loss \$65,000.

The shops of the Norfolk Southern at Newbern, N. C., were destroyed by fire on November 16; loss, \$200,000. Two locomotives were damaged and several freight cars were burnt up.

James J. Hill, in honor of whom a number of men have founded a professorship of transportation in the Graduate School of Business Administration, of Harvard University, has given to the university \$125,000, to be added to the like sum which was given by the founders.

The Nashville, Chattanooga & St. Louis reports that its expenses for clearing wrecks in the last fiscal year amounted to only \$6,521, which is equal to 59 cents out of every \$1,000 revenue received. Taking the records of all the railroads in the southern group, it appears that the average cost of clearing wrecks was \$2.40 to every \$1,000 gross revenue.

The eastern associations of general chairmen of the Brotherhood of Locomotive Engineers and the Brotherhood of Locomotive Firemen and Enginemen, in a joint session at Cleveland on November 17, decided to join the Brotherhood of Railroad Trainmen and the Order of Railway Conductors in their campaign for an 8-hour day and time and a half for overtime. It is said that formal action on this movement is to be taken at a meeting of the executive committee of the four brotherhoods at Chicago on December 15, when the formal ballot for a referendum vote of all of the members of the organization will be prepared.

General Manager Robert S. Parsons of the Erie Lines West has issued to enginemen a circular which, according to the *Cleveland Leader*, includes the following:

"If you were a passenger seated at a car window, or sleeping in a berth, you would not like to have a locomotive whistle blown just opposite you, giving you a severe attack of the 'jumps.'

"If you were a passenger you would not like to have the train come to a stop with a jolt rough enough to break the articles in your traveling bag and give you a general shaking up."

"Yet these annoyances occur every day, and many times a day, on the Erie Railroad—all because you do not realize the situation in which the passengers are placed. There is no rule or regulation that can stop these practices. It rests entirely upon your good nature and thoughtfulness. Will you strive to make an improvement?"

The Baltimore & Ohio has issued for its employees a treatise on first aid to the injured prepared by Dr. Joseph F. Tearney, chief medical examiner of the road. Discussing the effect of alcoholic liquors given in connection with sickness or accident, Dr. Tearney says: "Whiskey, even in small teaspoonful doses, increases the tendency to bleeding. When given in the somewhat larger quantity, known as the ordinary 'drink,' the first effect of

stimulation is followed by a corresponding depression, so that, when the surgeon arrives, he will have to lose valuable time in combating this depression, in addition to that caused by the shock of the accident. . . . If the sympathetic friend with the bottle tries to deaden pain with whiskey, he may produce intoxication and it is difficult to put a half-drunken man under an anaesthetic. It may be asked why the surgeon sometimes gives whiskey; the answer is that he knows how much to use and when not to use any. . . . Make it your iron-bound rule to allow the patient to have no whiskey or other alcoholic liquors."

## THE EMPIRE STATE EXPRESS

This famous train of the New York Central, the first regular long distance train in America to run at over 50 miles an hour, including stops, has begun its twenty-fifth year. It has covered a distance of 6,518,600 miles, equal to 14 round trips to the moon, and has carried approximately 8,000,000 passengers safely to their destinations. The record during these 24 years has been a remarkable one. Not one of its passengers has been fatally injured. One of its enginemen for sixteen years was Dennis J. Cassin, who last year was awarded the Harriman bronze medal in recognition of his unblemished record of safety.

When the Empire State Express was first placed in service it weighed only 230 tons; now it weighs 780 tons. It was drawn by engines of the "870" class, and later by the famous "999," the locomotive that took the prize at the Chicago World's Fair. Nowadays that locomotive looks like a toy in comparison with the giant Pacific type, and it could hardly start the train, much less haul it on its fast schedule.

## CAR AND LOCOMOTIVE ORDERS IN NOVEMBER

During the month of November, orders for locomotives, freight cars and passenger cars were reported as follows:

	Locomotives.	Freight Cars.	Passenger Cars.
Domestic .....	200	13,700	327
Foreign .....	6	1,000	...
Total .....	206	14,700	327

Among the more important orders for locomotives were the following: Elgin, Joliet & Eastern, 18 Mikado and 9 switching locomotives, American Locomotive Company; Baltimore & Ohio, 14 Mallet type locomotives, Baldwin Locomotive Works, and 15 of the same type, American Locomotive Company; New York, New Haven & Hartford, 33 Mikado type locomotives, American Locomotive Company, and the Pennsylvania Lines West, 48 Consolidation locomotives, American Locomotive Company, and 15 of the same type, Lima Locomotive Corporation.

The New York Central was reported in last month's issue, page 599, as having ordered 9,000 freight cars. During November additional New York Central orders were reported, aggregating 3,000 cars. Of these, 2,000 were for the New York Central itself, orders having been reported as follows: Pressed

## RAILROAD CLUB MEETINGS

Club	Next Meeting	Title of Paper	Author	Secretary	Address
Canadian.....	Dec. 14....	Pure Iron and Its Use by Railway Companies.	J. T. Hay.....	James Powell....	St. Lambert, Que.
Central.....	Dec. 10....			Harry D. Vought	95 Liberty Street, New York
New England.....	Dec. 14....	Efficiency in Track Work....	S. L. Connor.....	Wm. Cade, Jr....	683 Atlantic Avenue, Boston, Mass.
New York.....	Dec. 17....	Annual Meeting....		Harry D. Vought	95 Liberty Street, New York
Pittsburgh.....	Dec. 21....	The Life of the Steel Freight Car....	S. Lynn.....	J. B. Anderson....	207 Penn Station, Pittsburgh, Pa.
Richmond.....	Dec. 13....	Moving Pictures National Tube Company....	C. F. Roland.....	F. O. Robinson....	C. & O. Ry., Richmond, Va.
St. Louis.....	Dec. 10....	Annual Meeting....		B. W. Frauenthal....	Union Station, St. Louis, Mo.
South'n & S'w'r'n.....				A. J. Merrill....	Box 1205, Atlanta, Ga.
Western.....				Jos. W. Taylor.....	1112 Karpen Bldg., Chicago, Ill.
Western Canada.....				Louis Kon.....	Box 1707, Winnipeg, Man.

Steel Car Company, 500 gondola cars; Standard Steel Car Company, 500 gondola cars; Haskell & Barker Car Company, 500 box cars, and the American Car & Foundry Company, 500 box cars. The other 1,000 cars were hopper cars ordered from the Standard Steel Car Company for the Pittsburgh & Lake Erie. Among other important orders were: The Western Maryland, 1,000 additional hopper cars, Pullman Company; the Western Pacific, 1,000 box cars, Pullman Company; the Chesapeake & Ohio, 2,000 coal cars, Standard Steel Car Company, and the Central of New Jersey, 1,000 hopper cars, Standard Steel Car Company, 500 box cars, Standard Steel Car Company, and 750 box cars, American Car & Foundry Company.

The largest passenger car order reported during the month was that placed by the Interborough Rapid Transit Company of New York with the Pullman Company for 234 motor car bodies and 77 trailer car bodies for the company's new rapid transit lines. The Philadelphia & Reading ordered 20 coaches and 10 combination cars from the Harlan & Hollingsworth Corporation.

#### MEETINGS AND CONVENTIONS

*American Society of Mechanical Engineers.*—The annual meeting of the American Society of Mechanical Engineers will be held at the Engineering Societies' building, 29 West Thirty-ninth street, New York City, on December 8, 9 and 10, 1915. The railroad session will be held on Wednesday afternoon, December 8. The subcommittee on railroads has endeavored to provide a program of unusual interest, and papers will be presented dealing with both locomotives and cars. The papers were announced in last month's issue.

*June Mechanical Conventions.*—The meeting of the executive committee of the Master Car Builders' Association, the American Railway Master Mechanics' Association and the Railway Supply Manufacturers' Association was held in Chicago on November 15. It was decided that the next annual convention of the Master Car Builders' and the Master Mechanics' Associations would be held at Atlantic City, starting June 14, the Master Car Builders' convention being held first and the Master Mechanics' convention the following Monday. The city of Chicago would undoubtedly have been chosen as the convention meeting place had the Municipal Pier been ready for occupancy at that time. It is believed that in future years the June conventions will be held at that place.

*The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations:*

- AIR BRAKE ASSOCIATION.—F. M. Nellis, 53 State St., Boston, Mass.
- AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—W. E. Jones, C. & N. W., 3814 Fulton St., Chicago.
- AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.—J. W. Taylor, Karpen Building, Chicago.
- AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—Owen D. Kinsey, Illinois Central, Chicago.
- AMERICAN SOCIETY FOR TESTING MATERIALS.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.
- AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Annual meeting, December 7-10, 1915, New York.
- ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreuccetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.
- CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 841 North Fiftieth Court, Chicago. Second Monday in month, except July and August, Lytton Building, Chicago.
- CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—W. R. McMunn, New York Central, Albany, N. Y.
- INTERNATIONAL RAILWAY FUEL ASSOCIATION.—C. G. Hall, 922 McCormick Building, Chicago.
- INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1126 W. Broadway, Winona, Minn.
- INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—A. L. Woodworth, Lima, Ohio.
- MASTER BOILER MAKERS' ASSOCIATION.—Henry D. Vought, 95 Liberty St., New York.
- MASTER CAR BUILDERS' ASSOCIATION.—J. W. Taylor, Karpen Building, Chicago.
- MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION OF U. S. AND CANADA.—A. P. Dane, B. & M., Reading, Mass.
- NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—E. Frankenberger, 623 Brisbane Building, Buffalo, N. Y. Meetings monthly.
- RAILWAY STOREKEEPERS' ASSOCIATION.—J. P. Murphy, Box C, Collinwood, Ohio.
- TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, N. Y. C. R. R., East Buffalo, N. Y.

## PERSONALS

### GENERAL

R. A. BILLINGHAM, master mechanic of the Tennessee Central, at Nashville, Tenn., has been appointed mechanical superintendent, and the office of master mechanic has been abolished.

H. W. CATHCART has been appointed assistant fuel and locomotive inspector of the Philadelphia & Reading at Reading, Pa.

M. E. HAMILTON, northwest railroad representative of the Garlock Packing Company, with headquarters at St. Paul, Minn., has been appointed general air brake inspector of the St. Louis & San Francisco. Mr. Hamilton was formerly general air brake instructor on the Atchison, Topeka & Santa Fe.

T. E. HESSENBRUCH has been appointed fuel and locomotive inspector of the Philadelphia & Reading at Reading, Pa.

### MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

J. W. BAUM, general foreman of the Lake Erie, Franklin & Clarion, at Clarion, Pa., has been appointed master mechanic, and the position of general foreman has been abolished.

H. A. ENGLISH has been appointed master mechanic of the Canadian Northern, Central division, with headquarters at Winnipeg, Man., succeeding G. H. Hedge, promoted.

E. E. KEYSER has been appointed assistant road foreman of engines of the third and fourth divisions, Virginian Railway, at Princeton, W. Va.

B. E. NEVINS has been appointed road foreman of engines of the first and second divisions, Virginian Railway, at Victoria, Va.

C. J. QUANTIC has been appointed master mechanic of the Canadian Northern, Pacific division, at Port Mann, B. C.

F. RONALDSON, formerly locomotive foreman of the Canadian Pacific at Lambton, Ont., has been appointed district master mechanic at Farnham, Que., succeeding H. Pepler.

### CAR DEPARTMENT

H. J. WHITE has been appointed supervisor of car work of the Canadian Northern, eastern lines. Mr. White was born in Brownington, Vermont, April 1, 1871. He commenced railway work in May, 1893, as car repairer and joint car inspector for the Boston & Maine and the Canadian Pacific at Newport, Vermont, which position he held till September, 1894, when he was transferred to St. Polycarpe Junction as joint car inspector for the Canadian Pacific and Canada Atlantic (now part of the Grand Trunk Railway system). In May, 1900, he became car inspector for the Canadian Pacific at Parkdale, being transferred in November of the same year to Union Yards, Toronto, in the same capacity, where he remained un-

til February, 1903. He was then made leading hand carpenter at the Canadian Pacific car shops at Outremont. In September, 1906, he became car foreman and wrecking foreman of the Ca-



H. J. White

nadian Pacific at North Bay, later being transferred to the West Toronto shops as general foreman. In November, 1913, he was appointed general foreman, car department of the Quebec Grand Division of the Canadian Northern, which position was held until his recent appointment, as noted above.

W. E. GROVE has been appointed assistant general car inspector of the Philadelphia & Reading at Reading, Pa.

W. H. PIERIE, formerly charge hand, has been appointed car foreman in the shops of the Intercolonial at Halifax, N. S., succeeding D. W. Murray, assigned to other duties.

#### SHOP AND ENGINE HOUSE

W. L. Kinsell, chief clerk to David Van Alstyne, assistant to the vice-president of the New York, New Haven & Hartford, has been appointed assistant shop superintendent at Readville, Mass.

#### PURCHASING AND STOREKEEPING

H. W. BOWEN has been appointed assistant storekeeper of the Baltimore & Ohio at Locust Point, Baltimore, Md.

F. B. CALHOUN has been appointed division storekeeper of the Atchison, Topeka & Santa Fe, at Waynoka, Okla.

W. D. FRANCIS has been appointed assistant storekeeper of the Baltimore & Ohio at Cleveland, Ohio, succeeding C. H. Rothgary, who has been promoted.

J. HARVEY has been appointed storekeeper of the Canadian Pacific at Havelock, Ont., succeeding A. Dobson transferred.

W. M. HINKEY has been appointed storekeeper of the Baltimore & Ohio at Kuper, W. Va., succeeding F. C. Winter.

James L. Woods has been appointed purchasing agent of the Nashville, Chattanooga & St. Louis with headquarters at Nashville, Tenn., succeeding A. C. Taylor, assigned to other duties.



J. L. Woods

In 1914, he served in various clerical capacities in the Atlanta freight agency at Atlanta, becoming chief clerk. From that position he was promoted to the position of assistant purchasing agent.

C. LAVENDER has been appointed storekeeper of the Canadian Pacific at John Street, Toronto, succeeding W. H. Bainbridge transferred.

C. H. ROTHGARY, assistant storekeeper of the Baltimore & Ohio at Cleveland, Ohio, has been appointed storekeeper at Lorain, Ohio, succeeding H. J. Cobb, resigned.

A. J. SWEING, chief clerk to the purchasing agent of the Wabash, has been appointed general storekeeper, with headquarters at St. Louis, Mo. This is a newly created office.

GEORGE G. YEOMANS has been appointed purchasing agent of the New York, New Haven & Hartford, with headquarters at Boston, Mass. Mr. Yeomans was born on January 11, 1860, at Trenton, N. J., and graduated from Princeton University. He began railway work in 1882, as rail inspector on the Chicago, Burlington & Quincy. From 1884 to 1886, he was a clerk in the purchasing department, and then to 1891, was chief clerk of the same department. From 1891 to March, 1898, he was assistant purchasing agent, and in March, 1898 was promoted to purchasing agent of the same system, remaining in that position until July, 1905. He served from July to October, 1905, as assistant to first vice-president of the Wabash Railroad and as assistant to president of the Wheeling & Lake Erie, the Wabash Pittsburg Terminal, the Pittsburg Terminal Railroad Coal Company and the West Side Belt. From October, 1905, to March, 1912, he was assistant to president of the same roads. Since then he has made a study of methods of purchasing and handling supplies on several roads.

#### OBITUARY

WILLIAM FREDERICK ALLEN, general secretary of the American Railway Association and its predecessors, since 1875, and manager of the Official Railway Guide since 1873, died on November

9 at his home in South Orange, N. J. Mr. Allen was one of the most widely known men in American railroad life. He was born October 9, 1846, at Bordentown, N. J., and received his education in the Bordentown Model School and the Episcopal Academy in Philadelphia. He began railway service in May, 1862, as a rodman in an engineering corps of the Camden & Amboy, becoming in May, 1863, assistant engineer of the same road. From February, 1868, to 1872, he was resident engineer of the West Jersey Railroad. In 1872 he entered the ser-

vice of the National Railway Publication Company, and shortly afterwards was made assistant editor of the Official Railway Guide. In June, 1873, he became the editor and manager of the Guide, and has been at the head of it ever since. In April, 1875, he was appointed secretary of the General Time Convention and in October, 1877, of the Southern Railway Time Convention. In April, 1886, the American Railway Association succeeded these organizations and Mr. Allen continued as secretary, holding the position of general secretary and treasurer at the time of his death.

In 1910 Mr. Allen was elected vice-president of the National Railway Publication Company and since 1914 had been its president. At the time of his death he was also secretary of the General Managers' Association of New York and the Bureau for the Safe Transportation of Explosives.

In his capacity as secretary of the American Railway Association Mr. Allen has become intimately acquainted with a larger number of railway managers than any other man in the country. The presidency of the association has been held by different men, from different parts of the country, but the secretaryship has been a permanent feature, and his administration of the office has been an important element in the association's prosperity.

Outside the railroad world Mr. Allen was known chiefly as the "father of standard time." To him was referred for solution, in 1881, the problem of working out a standard of time reckoning

that would obviate the confusion resulting from the use of the fifty-odd standards then prevailing on the railroads in the United States. His report was submitted to the Association in 1883. It provided for an elastic boundary line between the hour zones, instead of a strictly longitudinal division; and in its details fixed every point at which the hour change was to be made, and embodied every practical provision for putting the system into immediate effect. The report was unanimously endorsed by the Association, and Mr. Allen thereupon accomplished the unique diplomatic task of securing its adoption by the numerous diverse interests whose approval was essential to success.

The change in the operating time tables of the many different railroads was made at noon, eastern time, on Sunday, November 18, 1883, without delay or disturbance. For this achievement Mr. Allen was elected to honorary membership in many American and foreign scientific societies, and received the honorary degree of master of science from Princeton University. Mr. Allen was a delegate of the United States Government to the International Meridian Conference in 1884, and to the International Railway Congress at Paris in 1900. He was a delegate of the American Railway Association to the International Railway Congresses at London, 1895; Paris, 1900; Washington, 1905; Berne, 1910. Since 1910 he has been a member of the Permanent Commission of the Congress Association.

In 1905 he had charge of all the arrangements for the session at Washington. For his services in this connection he was decorated with the order of Leopold by the Belgian Government.

JAMES F. DEVY, assistant superintendent of motive power for the Chicago, Milwaukee & St. Paul, at Milwaukee, Wis., died at his home in that city on November 5, following an illness of eight months. He was born in Ithaca, N. Y., on June 23, 1866, and graduated from Cornell University in 1888. During his college career he won distinction not only as a football player and crew man, but as an honor student in the college of mechanical engineering. Following his graduation he entered the service of the New York Central in its mechanical department, where he remained for seven years. He was then employed by the American Locomotive Company both at Dunkirk, N. Y., and Schenectady. Fifteen years ago he came to Milwaukee as chief draftsman in the mechanical department of the Chicago, Milwaukee & St. Paul. On September 1, 1902, he was promoted to mechanical engineer, and on April 15, 1910, he was appointed assistant superintendent of motive power. At the time of his death he was a member of the executive committee of the American Railway Master Mechanics' Association, a member of the committee on design, maintenance and operation of electric rolling stock, and also a member of the committee on brake shoes and brake beam equipment and the coupler committee of the Master Car Builders' Association. From 1910 to 1911, he was president of the Western Railway Club.

R. B. SALMON, master mechanic of the Louisville & Nashville at Covington, Ky., died on November 3, at Covington.

R. S. STEPHENS, until June 1, 1913, purchasing agent at Houston, Texas, for the Galveston, Harrisburg & San Antonio, the Houston & Texas Central, and the Texas & New Orleans, died at his home in Houston on November 2.



J. F. Devoy

## SUPPLY TRADE NOTES

Elmer B. Van Patten has been appointed sales representative of the Acme Supply Company, with headquarters at Chicago, Ill.

J. M. Spangler, formerly with the Railroad Supply Company, Chicago, has recently entered the service of the National Carbon Company, Cleveland, Ohio.

L. T. Burwell, formerly with the M. W. Supply Company, Philadelphia, Pa., has become associated with the Q & C Company, N. Y.

Frank R. Peters, formerly with J. Stone & Co., London, England, has joined the electrical staff of the Franklin Railway Supply Company, New York.

R. W. Burnett, for many years general master car builder of the Canadian Pacific, has been elected vice-president of the National Car Equipment Company, of Chicago, Ill.

C. B. Little, formerly an electrical engineer in the service of the Baltimore & Ohio, has resigned to enter the service of the Franklin Railway Supply Company, New York.

The Toledo Scale Company announces that H. O. Hem, formerly of Kansas City, Mo., has become a member of its engineering staff in the capacity of consulting engineer, and has opened an office at Toledo, Ohio.

G. C. Pool, formerly with Guilford S. Wood, Chicago, and previous to that with the Acme Supply Company, Chicago, has become connected with the Q & C Company, New York. His attention will be given particularly to Q & C devices for locomotives and cars.

Frederic H. Poor, who since the incorporation in December, 1909, of the S. K. F. Ball Bearing Company, of New York, has been its general manager, has recently severed his connection with that organization, and has opened an office of his own at 30 Church street, New York.

R. W. Gillispie, New York district sales manager of the Pennsylvania Steel Company, has been appointed general manager of sales, succeeding John C. Jay, Jr., who has resigned from his position as vice-president and general manager of sales to become chairman of the Maxwell Motor Company.

The Chicago Railway Signal & Supply Company opened two new branch offices, on October 15, one located at 407 Confederation building, Winnipeg, Man., and the other at 320 Kearns building, Salt Lake City, Utah. W. Reynolds will have charge of the company's Canadian interests, and C. H. Jones will act as representative for the western district, having Salt Lake City as its center.

The S. K. F. Ball Bearing Company, of Hartford, Conn., recently incorporated with a capital of \$2,000,000, to take over the business of the S. K. F. Ball Bearing Company, of New York, a house importing ball bearings made in Sweden, is about to erect a factory at Hartford, Conn. The new company has acquired the right to manufacture the S. K. F. ball bearings, formerly made in Sweden. Its directors are: Frank A. Vanderlip, of the National City Bank; B. M. W. Hanson, vice-president of Pratt & Whitney; Franklin B. Kirkbride, 7 Wall Street, New York; A. Carlander and S. Winguist, directors of the Swedish S. K. F. Company, which is a large holder in the new American corporation, and B. G. Prytz, who will act as president.

J. Leonard Reogle, vice-president and general manager of sales of the American Vanadium Company since March 1, 1915, and prior to that vice-president and general manager of sales of the Cambria Steel Company, on November 12, purchased from the Pennsylvania company approximately 240,000 shares of stock in the Cambria Company at a price of almost \$15,000,000. Mr.

Reprogle's holdings do not give him control of the Cambria Steel Company. The latter is capitalized at \$50,000,000, of which \$45,000,000 is outstanding in shares of \$50 par value. The Pennsylvania Company (Pennsylvania Lines west of Pittsburgh) a short time ago held \$22,504,000 of this, or slightly over 51 per cent. It later sold \$98,000 shares in the open market and recently William H. Donner, president of the Pennsylvania and Cambria Steel Companies, exercised options for the purchase of 112,000 shares. It is understood that the syndicate for which Mr. Replogle is acting controls more than the 240,000 shares acquired from the Pennsylvania Company, but it is not believed that they have a majority control. Mr. Donner and H. C. Frick had been taking action leading to a possible merger of the Pennsylvania and Cambria Steel Companies.

Isaac M. Cate, a large stockholder, has renewed his attack on the organization and management of the American Locomotive Company by sending first to the directors and now to the other stockholders a 58-page printed letter reciting the findings of his accountants and other details. Mr. Cate attacked the management of the company in February, 1912, directing his efforts against Waldo H. Marshall, president, and a number of other officers particularly. The board authorized an inquiry of Mr. Cate's charges of mismanagement, waste and misconduct, but the report of the committee of inquiry did not support Mr. Cate. In September, 1914, Sylvanus L. Schoonmaker was elected chairman of the board. This appeased Mr. Cate for a time, but not for long. In his present letter Mr. Cate seeks to discount the ability of the present management of the company. Concerning its war orders, he says: "Those in your company who did not make automobiles at a profit or develop the superheater or build locomotives in competition with the Baldwins are not the men to extract profits from shrapnel shells. The contract for shells was taken on April 15, with everything laid out for speedy preparations. There have been nearly six months of preparation. If the production of shells is subject to such prodigious cost as my accountant finds pervades the organization it will not be possible to compete with other institutions."

Harry D. Rohman, who was recently appointed chief electrical engineer of the Franklin Railway Supply Company, New York, was born in Switzerland in 1883. Upon his graduation as an electrical engineer from the technical schools of Zurich, he entered the works of the Oerlikon Electrical Construction Company. There he was afforded an opportunity of combining a practical training with the theory of engineering, and in 1903 qualified as an electrical engineer, with experience in high and low tension and A. C. and D. C. work, especially electrical traction. Later he entered the service of J. Stone & Co., London, and gradually worked up through its various departments until in 1910 he was appointed chief of the test-



H. D. Rohman

ing and experimental departments. In April, 1914, he was appointed chief assistant electrical engineer, and held that position until October 1, 1915, when he entered the service of the Franklin Railway Supply Company as noted above. Mr. Rohman speaks several languages and has had an extensive experience in all European countries, including the Balkan States, in South Africa and the Belgian Congo.

## CATALOGS

**CONDENSERS.**—The Mesta Machine Company, Pittsburgh, Pa., has recently issued Bulletin R, dealing with the line of barometric condensers made by that company.

**LOCOMOTIVE APPLIANCES.**—The Franklin Railway Supply Company, New York, has recently issued Bulletin No. 166, describing and illustrating the Franklin automatic adjustable driving box wedge.

**STORAGE BATTERIES.**—Bulletin No. 12, recently issued by the General Lead Batteries Company, Newark, N. J., deals with the use of the hydrometer syringe made by that company and tells how to recharge batteries.

**KEROSENE TORCHES.**—The Hauck Manufacturing Company, Brooklyn, N. Y., has recently issued bulletin No. 60, entitled, Saving Ways in Busy Shops, dealing with the company's burners and furnaces for kerosene and other oil fuel. The booklet contains a number of illustrations of the various burners and others showing the work which may be done by them.

**WATER SOFTENING.**—The L. M. Booth Company, New York, has recently issued a bulletin relative to the company's type F water softeners. The booklet is attractively illustrated. It explains the operation of the softeners in detail, showing sectional views of the softeners at work. There are also given a number of views of typical installations.

**SIMPLEX LETTERING TEMPLETS.**—The Keuffel & Esser Company, New York, has issued a leaflet describing its transparent dylonite templets for lettering engineering and architectural drawings, etc. The templet contains two holes with perforations of different sizes by means of which the letters of the alphabet and numerals may be spaced correctly and outlined. Glass and Payzant pens suitable for use with these templets are also described.

**CENTRIFUGAL PUMPS.**—Catalog H-2, recently issued by the Lea-Courtenay Company, Newark, N. J., describes and illustrates the various types and sizes of Lea-Courtenay centrifugal pumps. The booklet, containing 64 pages, is divided into 12 chapters, dealing respectively with the care taken in the manufacture of this company's product and the characteristics of the pump. The booklet is profusely illustrated.

**SAVING SET-UPS IN RAILROAD SHOPS**—This is the title of a booklet which has recently been issued by the Lucas Machine Tool Company, Cleveland, Ohio. The booklet relates particularly to the Lucas "Precision" boring, drilling and milling machine and aims to show wherein that machine is productive of efficiency in the railroad shop. The catalog is well illustrated and attractively gotten up.

**STORAGE BATTERIES.**—The Titan Storage Battery Company, Newark, N. J., has issued a very attractive catalog relative to the company's line of storage batteries. The booklet touches upon the company itself and its aims, and treats of Titan storage batteries under the following heads: storage battery parts; elementary theory of the storage battery; Titan pasted plates, measurements, etc. Colored illustrations are given of the batteries and their parts.

**IRON PIPE.**—The A. M. Byers Company has recently issued Bulletin No. 26, dealing with the excellencies of Byers genuine wrought iron black and galvanized tubing, casing, line pipe and drive pipe. The bulletin contains considerable useful information about Byers pipe, such as its resistance to corrosion, fabricating qualities, welding qualities, specifications for genuine wrought iron pipe and details about hand puddling, rolling of muck bar, skelp, etc. In the back of the book are complete tables showing not only list prices, but dimensions, areas, hydrostatic tests, etc. There are also given specific cases showing the superior rust resistance of Byers in the same service with cheaper grades of pipe.

